Draft

The potential environmental and social impacts of a plantation project in Uruguay

With tools for planning and monitoring

A report for Stora Enso: August 9th 2007

Foreword

To come from Stora Enso

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Acknowledgements

We are grateful for the chance to carry out a study with this degree of freedom and acknowledge the lead taken by Stora Enso in investing in a detailed survey at a time when they could have got away with doing far less. If the study and accompanying tools work, we have an opportunity to help set best practice for fast wood plantations far beyond the current project and country. The tools being developed will hopefully be useful throughout the region – in some cases throughout the world.

Many people have helped in the practical collection of information in Uruguay and elsewhere [a full acknowledgement list will be included in the final volume]. We are also grateful for expert comment from Dr Sadanandam Nambiar and Professor Walter de Paula Lima.

Personal note from Nigel Dudley: Some background: I was involved in some of the earlier critiques of the pulp industry from the perspective of forest management (Dudley 1992, Dudley et al 1993 etc) and was later coordinator of WWF's global forest strategy (Dudley et al 1995), which recognised that whilst the organisation had many questions about the way in which plantations were being developed, it believed that they did have a role within the landscape. Following that, I coordinated an Environmental and Social Impact assessment for Enso Oy – one of the precursor companies of Stora Enso – in Kalimantan, Indonesia in 1997. During the late 1990s and early 2000s I was involved in best management practices for plantations in association with WWF, IUCN and the Center for International Forestry Research. After a number of years when my main professional interests have focused on protected area management, the current project represents a return to earlier interests. Stora Eno is to be applauded for inviting a sceptic to look at the project and for the freedom they have given to research into and write what I and my fellow researchers thought was needed.

Summary of key conclusions

NOTE: This is not a final summary. It includes the current draft of key points that the company might note in relation to further development – final draft will be completed when the Environmental Management System is prepared and a final assessment can be completed, by mid-August…

The current study is an assessment of the potential impacts of the Stora Enso plantation development in Uruguay, which has four main aims, to:

- ✓ Provide a background analysis of likely risks – particularly from a social and environmental perspective – from the plantation project
- ✓ Assess the current situation within the area being investigated for possible plantation sites with respect to physical, biological and social conditions and also to understand the attitude of local and national stakeholders
- ✓ Suggest the main areas where Stora Enso should focus management efforts from environmental and social perspectives
- ✓ Develop a series of tools that could help achieve these aims

Plantations have been criticised from various perspectives: especially because of their environmental impacts, the social effects of large plantation projects and the political implications of large off-shore companies buying land and running major projects in poorer countries. Stora Enso can do nothing directly about the last of these, but we believe that it is in a strong position to provide leadership in designing a world class plantation project that can address the social and environmental issues that have been of concern to campaigners. To do this, it will need in particular to address the following key issues:

Environment: key issues

■ **Biodiversity**: **recognition of the key importance of grasslands and inclusion of conservation measures for grassland within management strategies** including:

- ✓ **High conservation value areas (HCVA)**. Using field keys to identify the highest value grasslands. In extreme cases not buying land for plantations if it is going to degrade the most important habitat; more usually deciding where to plant within a plot to preserve the most valuable grassland areas
- ✓ **Good management and restoration** (grassland and other habitats). This covers all high quality grassland but also natural woodland, *Butia* palm areas and wetlands and includes both avoidance of planting and positive management measures to maximise and improve conservation values
- ✓ **Private protected areas** through set-aside areas. Active exploration with government protected area agencies of the potential for adding set aside areas to be part of the national protected area network, which is currently being expanded

- ✓ **Landscape approaches** to planning, creating a viable mosaic of linked natural and semi-natural habitats: using a series of tools (corridors, stepping stones, multiple-aged forest stands, buffer zones, artificial habitats etc) to maintain biodiversity within the plantation estate. Should include HCVA planning, ecosystem integrity and trade-offs of land use.

■ **Water balance: care to avoid localised impacts on neighbours through**:

- ✓ **Aquifers** avoid planting in aquifer recharge areas through use of the forest suitability map to identify higher risk areas and within these carrying out site surveys

- ✓ **Superficial water quality** avoid planting close to standing or running water to reduce impacts on water quantity and quality

- ✓ **Superficial water quantity** avoid over-planting within a single watershed

■ **Integrated management system [IMS]**: **building on the Uruguay Forestry Code and focusing on key areas often neglected in management including**: [refer to full list]

- ✓ **Transport policy** to avoid the social and environmental impacts of transport incliding for example liaison with local communities to avoid transport during key periods (mass etc) and avoiding transport in weather conditions likely to lead to road deterioration – for example by increasing the wood store size at the mill to allow suspension of transport in bad weather

- ✓ **Agrochemical use** with particular emphasis on worker safety, site-specific fertilizer use, avoiding drift of herbicides and minimum use of safest possible pesticides against ants

- ✓ **Worker safety** regarding in particular machinery use, safety equipment, chemical handling

- ✓ **Outgrower schemes** requirement for application of IMS for all timber used by the company including from outgrower schemes

Society: key issues

■ **Transparency**: **full information to local communities (currently not always being done) through**:

- ✓ **Stakeholder involvement:** Regular meetings (including the Landscape Outcome Assessment Methodology [LOAM] process) to ensure that the local communities know what is happening, including meeting with workers' groups (including trades unions), local officials and villagers. Specific liaison officers should be responsible for community relations (note that this will usually not be a full time job and may for instance be the local manager but the role should be explicitly identified and terms of reference developed)

- ✓ **Communication**: Publicity materials including leaflets, article in local newspapers, radio interviews etc

■ **Contractors**: **ensuring that contractors maintain the high standards of the company and employ the full Integrated Management System etc through**:

- ✓ **Standards** created by clear guidance and terms of reference in contracts setting out requirements for safety, treatment of workers, environmental and social issues backed up by training courses for contracted workers where necessary (we note there are already initial standards in place and some contractor training has started).

- ✓ **Internal evaluation and monitoring** of contractors through a standardised annual monitoring and enforcement system, to provide positive discrimination, leading to a construcitve, evolving long term relationship with key contractors. This should ensure stability and encourage companies to have a stake in the long-term future of the project.

■ **Local benefits**: ensure that a reasonable proportion of the benefits reach local communities including by

- ✓ **Increasing local economic opportunities** including where possible jobs for people from local communities and deliberate use of local services

- ✓ **Encouraging local benefits** through supporting additional training opportunities for local workers and additional benefits such as access to beekeepers

Tools

Over the course of developing the assessment of the potential impacts, we have developed a range of tools that could be useful in implementing these and other recommendations, and also summarise some others, already available, that might provide a useful framework for management. These include:

Developed for Stora Enso:

- ✓ **Rights-based development**: an overview of rights based approaches and a draft set of guidelines for use in plantation development

- ✓ **Toolkit for site selection and planning**: a set of indicators agreed by a cross-disciplinary experts' workshop, drawing on in-country research, to help to identify high value areas within sites to aid planning

- ✓ **Methods for monitoring ecosystem integrity**: draft set of indicators that provide an accessible and feasible monitoring system for social and environmental outcomes from the project, again drawing on expert opinion

- ✓ **Forest suitability map**: map of key areas most suitable or unsuitable for purchase within the landscape being investigated by Stora Enso

- ✓ **Recommendations for sustainable landscape planning**: key techniques for planning plantations at a landscape scale

- ✓ **Advice on environmental management systems**: analysis of over 50 codes of practice from around the world and development of best practice, building on the current voluntary Uruguay Forestry Code

Other tools that Stora Enso might draw on

- ✓ **Landscape Outcome Assessment Methodology**: developed by WWF to provide long-term monitoring of outcomes of major development or conservation projects

- ✓ **High Conservation Values**: expansion of the High Conservation Value Forest concept to other ecosystems – in this case grassland

In addition, to help the prioritisation process, we have used a matrix to compare the right based approach suggested with the primary concerns expressed by stakeholders to suggest ways in which Stora Enso might respond to allay specific fears.

Introduction

Development of forest plantations has become one of the most intensely discussed topics in forest management. Proponents believe that plantations can reduce pressure on natural forests, produce a sustainable timber resource, help address poverty and social inequality and perhaps in the long term also supply an important contribution to global energy needs. Opponents believe conversely that if anything plantations can increase the rate of natural forest loss, creating a new range of social and environmental problems in the process, reducing local peoples' control over land in favour of large corporations and encouraging further wasteful consumption. Despite efforts to broker agreements about plantations, for example through the auspices of the United Nation's Intergovernmental Forum on Forestry, opinions have, if anything, polarised even further over the last few years.

There are examples of both good and bad plantations from around the world; and enough bad plantations to have created a determined opposition movement. The situation is further complicated because plantations are still developing – generally becoming more intensive but also being managed to minimise wastage, environmental damage and off-site effects. A series of international codes and norms have emerged to help provide a framework for good management and best practices: these are increasingly linked to third party inspection such as that offered by various certification schemes. The extent to which guidelines are adhered to, and the added value of certification schemes, are both still debated. The process of intensification is not yet over. There is for example strong pressure to move towards genetically modified trees (see for example Strauss et al 2001) and many plantations already rely on clonal varieties and encourage uniformity. In part because of the rapid way in which plantations are changing we still have a lot to learn about how modern intensive plantations should be managed.

A plantation bears the same relationship to a natural forest as a wheat field does to a meadow: both may have their place in the landscape but the differences need to be understood. There is a great opportunity for far-seeing companies to provide exemplars of high quality plantation management. However, given the problems that have arisen with plantations in some parts of the world, all developments are likely to be viewed initially with suspicion by at least some stakeholders.

The following document provides an analysis and an assessment of the potential impacts of the plantation project being developed by Stora Enso in Uruguay. It draws from the work of many different researchers, mainly in Uruguay but also based internationally. What follows hopefully reflects the diversity of thinking that has gone into the report. The experts commissioned in Uruguay all had the same terms of reference but tackled them in a variety of ways: some included much more theoretical discussion, some focused on recommendations for the company, others drew more heavily on opinions of local stakeholders etc. This diversity has helped us in understanding the complex set of conditions that relate to the plantation and to make what we hope are a reasonable set of recommendations. With this in mind we have attempted to retain at least some of the diversity within the report: the sections of analysis within Uruguay, although in each case rewritten at least in part by the editor, do not slavishly follow a single pattern but reflect the ways in which different groups of natural and social scientists tackled the issues. A full set of papers is available on CD and a volume of papers specifically on the landscape characterisation in Uruguay is planned.

Aims of the study

Background

The current study is not a classic Environmental and Social Impact Assessment but rather a risk analysis and provision of advice for the company.

The current study aims to:

- ✓ Assess the environmental and social risks associated with a large-scale plantation project in Uruguay
- ✓ Analyse plans and current practice by the company to judge the extent to which these risks are being mitigated
- ✓ Provide guidance, including some specially designed tools, to foster exemplary management.

The original terms of reference for the project were to carry out an environmental and social impact assessment (ESIA). A classic ESIA generally takes place before a project is started and analyses the stated intentions of any development, usually by drawing on a management plan or at least on operational plans. The theory is rooted in an assumption that developers state what they intend to do and independent assessors look at the plans and make a judgement as to the likely impacts, based on prior experience, field surveys, interviews with a range of stakeholders and other research results. ESIAs are designed mainly for infrastructure projects (e.g. roads, buildings) or for mines and are less well adapted for natural resource management projects where the time-frame for establishing the project is longer and many issues are addressed during development stage. In cases where an ESIA is a legal obligation, the assessment team may be asked to decide if the project should go ahead or not,. However, for several reasons, a classic ESIA is not suitable in this case:

Planting has already begun with almost 500 hectares of pines already established

Nigel Dudley

- ✓ The project has already started and so part of the analysis is of ongoing impacts as well as making predictions of future impact;
- ✓ There is no management plan to analyse, because the aims of the project are still being refined and some key decisions have yet to be made – for instance about the location (and to a certain extent even the existence) of a pulp mill, the mix of tree species to be planted and so on;
- ✓ The area under consideration for planting is evolving and is now twice as large as described when the project started, which also means that quite different planting processes may be needed on the new area;
- ✓ The Uruguay government does not require a detailed ESIA and the current study is a voluntary exercise by Stora Enso – this being the case there is no particular reason to keep to a model that does not fit the circumstances;
- ✓ Some information – particularly relating to the pulp mill – remains confidential – while this does not impact directly on the current study (which is limited to the plantation) it clearly has implications for the work – for instance with respect to transport routes for timber;
- ✓ A large part of the study is devoted to developing tools and methodologies for undertaking the plantation and to giving advice on approaches, both well beyond the scope of a standard ESIA.

We believe that some or all of these limitations are often in place in situations where a standard ESIA is carried out for large-scale natural resource management projects and that many professional assessments sketch over gaps in information, uncertainties and changing conditions. Impact assessments have a relatively low reputation and part of the reason is that they are often trying to operate in sub-optimal conditions.

Wonderful social and environmental policies are of little use if the company does not stay in profit….

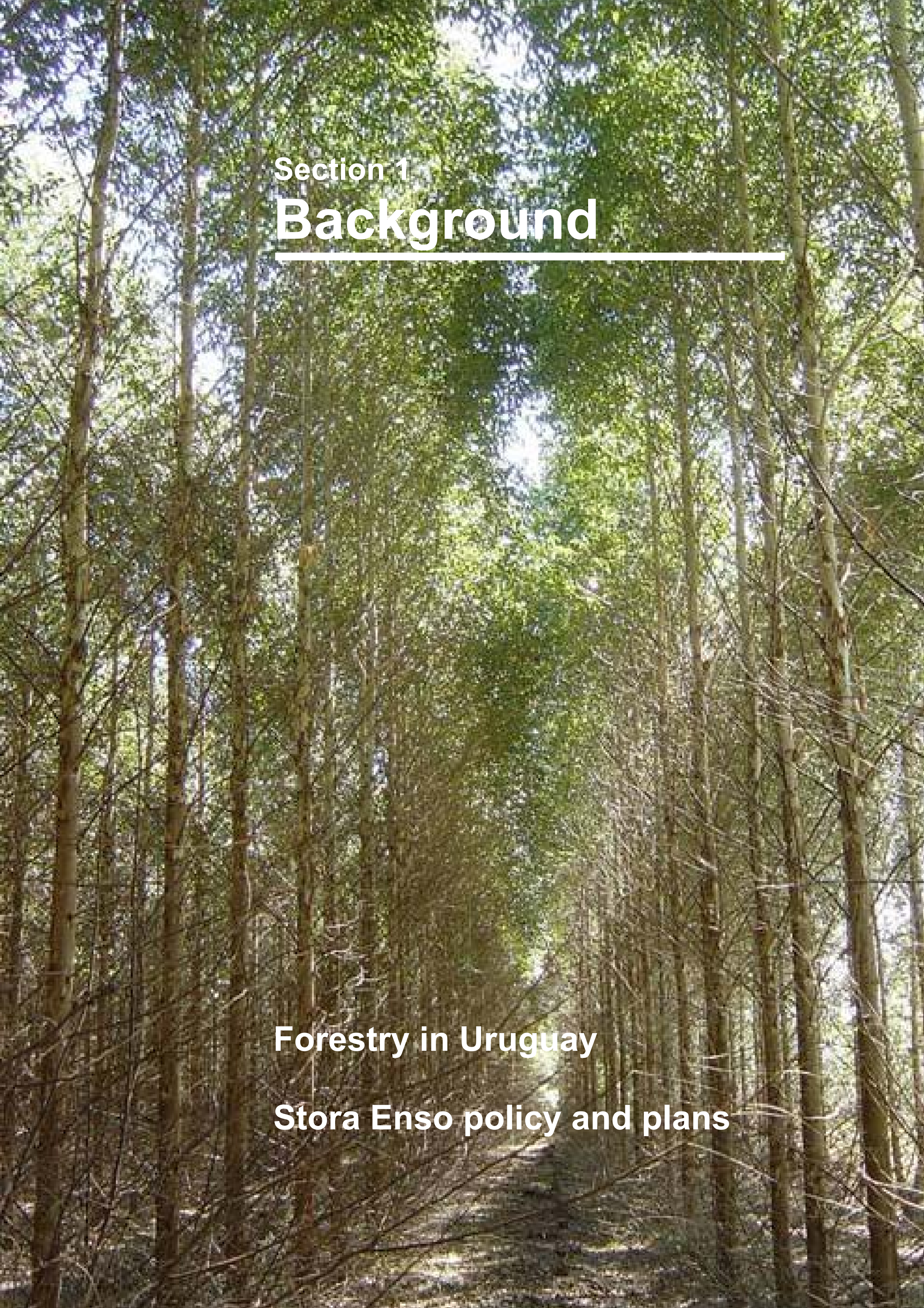
Yet there are good reasons for companies to delay finalising plans: they often need to learn about conditions in new parts of the world, the technical, political and economic conditions will continue to change during the project, and individual projects are affected by wider changes within the organisation, which may result in changes in direction. At the same time, the people working for or impacted by major development projects managed offshore have a right to some level of security with respect to plans and operations. One of the more justifiable concerns about a new and more flexible corporate model is that the additional manoeuvrability increases the risk that it will change, downgrade or discard projects more readily than was the case in the past. Impact assessments therefore not only need to look at what is planned but also try to make some predictions about future conditions to work out how a company or a government might react if conditions change and what the long-term implications will be. It also needs to consider issues of profitability. Wonderful social and environmental policies are of little use if the company does not stay in profit, because controls are likely to be abandoned as staff members rush to make up shortfalls, or a project can simply be sold on to other companies that may take little notice of any previous commitments. A new style of analysis is needed to take account of these realities.

The approach taken in this study

The study has developed from being a standard ESIA into something more akin to **a potential impact analysis with accompanying mitigation strategies**, aimed at helping Stora Enso to develop a project that could be an exemplar for such developments. The study has a number of distinct but related elements:

- ✓ Analysis of experience from around the world to identify potential impacts and assess their relevance to conditions in Uruguay
- ✓ Assessment of the whole landscape being considered for plantations to identify ecological and social factors likely to be affected by the plantation
- ✓ Interviews with representative stakeholders in communities within the broader landscape and in Uruguay about the plantation
- ✓ Assessment of the current operations in light of the global knowledge, landscape assessment, stakeholder interviews and the company's own Integrated Management System,
- ✓ Development of a series of tools to help improve plantation policy covering:
    - Rights-based approaches
    - Toolkit for site selection and planning
    - Methods for monitoring ecosystem integrity
    - Forest suitability map
    - Recommendations for sustainable landscape planning
    - Advice on environmental management systems

  And modifications to two existing tools for use in Uruguay
    - Landscape Outcome Assessment Methodology
    - High Conservation Values



Section 1

Background

Forestry in Uruguay

Stora Enso policy and plans

Forestry in Uruguay

Uruguay is one of the few countries in the world that is basing its entire forestry industry on intensive plantations (and by law protecting all its remaining natural forests). Over the last twenty years, plantation forestry has undergone a rapid expansion, peaking in 1997 at close to 60,000 hectares of eucalyptus established in a single year and falling off thereafter to an establishment rate of less than 10,000 ha per year, with pine establishment showing a similar fall (IFC 2006). The decline was blamed on several factors including increasing land prices, a fall in demand for wood, a mini economic "crisis" in Uruguay and, more recently, a reduction in incentives. With the current round of investments rate of establishment might increase once again.

Almost half a million hectares of plantations have been established in the last twenty years, encouraged by a range of incentive measures

Uruguay forest production is now based entirely on plantation forests – one of the few countries in the world to have made this decision

Development of forestry

Uruguay has a very low level of natural forest cover; although this has undoubtedly declined because of agriculture and other human activities, it would never have been high. But the type of grassland seen over much of the country today is not the original vegetation either; most of the land would under natural conditions be covered by bushes and scrub (see section on ecological history on page ##). Much of the grassland has been degraded by intensive grazing; in addition an increasing amount consists of planted species and there is also a large area cropland. Nonetheless, biologically rich, semi-natural *campos* pasture is an extremely important part of the ecology.

The government has actively encouraged plantation development for over twenty years, for example through the Forestry Act of Law 15.939 of December 15 1987, which provides tax benefits and financial subsidies for a proportion of tree establishment costs (see page ## for further details). The programme has been successful in attracting domestic investors and also companies from Spain, Finland, Canada and the United States amongst others (IFC 2006) and led to a rapid increase in rate of plantation establishment. The tax incentive programme is still in place but the financial subsidies were phased out gradually between 2004 and 2007.

Role in the economy

Silviculture contributes 0.8 per cent of the GDP of Uruguay (2004 figures), with the associated forest-products industry contributing a further 0.92 per cent (2003 figures). The area planted is now roughly equivalent to the remaining native forest area, made up of three quarters eucalyptus and a quarter pines. Ownership is entirely private, with five large companies owning 30 per cent of the total; if land owned by domestic and foreign pension companies is added the total in the hands of major companies rises to 53 per cent. The remainder is in the hands of small landowners and farmers (all figures from Morales 2006).

The total area of Uruguay is 17.3 million hectares, or which 3.57 million hectares have been characterized as "Forest Priority Soils" by the Dirreción Forestale, which means that they are eligible for tax breaks and incentives (see Table 1). All planting must be approved by the Dirreción Forestale.

Plantations generate jobs at an average rate of 28.6 employees per thousand hectares planted

Plantations generate jobs at an average rate of 28.6 employees per thousand hectares planted. In addition, 5,240 people worked in the associated industry in 2003, making up 6.25 per cent of industry employees, mainly in saw mills and pulp mills (ibid).

Recent research comparing rates of return for a range of exotic and native forest management systems in North and South America found the highest internal rate of return from eucalyptus plantations in South America (Cubbage et al 2007).

Type of plantations

Plantation establishment has focused almost entirely on eucalyptus and pine. Morales (2006) surveyed five companies and found that together they owned 391,000 hectares, 56.49 per cent of which (220,893 ha) was planted with trees. The main species planted with *Eucalyptus grandis*, *E. globulus*, *Pinus taeda*, *P. patula* and *P. elliotti*. Average rotation for eucalyptus was 15 years with average growth rates of 22 m^3 per year; rotation for pine averaged 23 years with annual growth of 20 m^3 per year.

Table 1: **Area of forest priority soils by selected forest regions in Uruguay**

Region	Department	Area
Central North	**Rivera**	**244,492**
	Tacuarembó	**316,413**
	Durazno	**272,149**
	Total	**833,054**
Littoral Rio Uruguay	**Paysandú**	**343,470**
	Rio Negro	**248,807**
	Soriano	**121,369**
	Total	**683,706**

Table adapted from IFC 2006

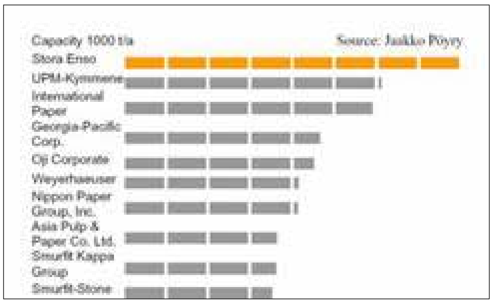
Plantations are most heavily concentrated in the central north of the country, the region in the west along the Rio Uruguay and the south central and south-east areas. Within the area of interest to Stora Enso, considerable plantation development has already taken place. For example in the departments of Rivera, Tacuarembó and Durazno, eucalyptus plantations in 2003 totalled 43,890 ha, 43,285 ha and 33,264 ha respectively (IFC 2006).

Timber from Uruguay plantations is mainly used for pulp, although there are also important domestic applications for hardwood timber

Stora Enso company profile and activities in Latin America

Stora Enso is currently the leading producer of paper and paperboard in the world, with 2006 sales of €14.6 billion. It employs 44,000 people, at present concentrated in Finland (28 per cent), Sweden (18 per cent), Germany (13 per cent) and North America (11 per cent). Corporate offices are located in Helsinki, Stockholm, Düsseldorf and London. It has annual production capacity of paper and board of 16.5 million tonnes plus 7.4 million m^3 of sawn wood products, including 3.2 million m^3 of value-added products.

Stora Enso has production facilities in Europe, North America and Latin America and Asia. Customers include publishers, printing houses and merchants, as well as the packaging, joinery and construction industries and are mainly concentrated in Europe, North America and Asia. In recent years the Group has been focusing on expanding its operations in new growth markets in China, Latin America and Russia



Comparison of Stora Enso with other major pulp and paper producers for 2006

The company's mission is to "promote communication and well-being of people by turning renewable fibre into paper, packaging and processed wood products." The company Vision and Values are outlined in the box below (Stora Enso 2007).

Vision

We will be the leading forest products company in the world

- ✓ We take the lead in developing the industry
- ✓ Customers choose us for the value we create for them
- ✓ We attract investors for the value we create
- ✓ Our employees are proud to work with us
- ✓ We are an attractive partner for our suppliers.

Values

- ✓ Customer focus - We are the customers' first choice
- ✓ Performance - We deliver results
- ✓ Responsibility - We comply with principles of sustainable development
- ✓ Emphasis on people - Motivated people create success
- ✓ Focus on the future - We take the first step

Changing geographies

Currently about 5 per cent of the wood and external pulp used by Stora Enso comes from plantations. This amount is expected to grow in the future, when the new plantation areas of Stora Enso come to production stage.

Stora Enso divested its Celbi plantations in Portugal in 2006 and Finnantara plantations in Indonesia in 2004.

The company continues to focus on and to grow its strategic wood fibre assets in Latin America and China. Currently Stora Enso owns the following plantations and associated industries:

– **Veracel, Brazil** (50 per cent ownership)**:** the Veracel pulp mill started production in May 2005. Production capacity is 900 000 tons per year of Bleached Eucalyptus Kraft pulp. At the end of 2006, 77,000 ha of *Eucalyptus* was planted and approximately 100,000 ha of Veracel's lands were set aside for conservation and restoration of the native Atlantic Rainforest. In addition approximately 14,000 ha of land have been planted by third parties under a tree-farming programme. Stora Enso's 50 per cent share of the output is utilised in its mills in China, Finland and Germany. Veracel is one of the largest private-sector investments in Brazil in recent years; total investment in plantations, mill and infrastructure is about US$1.2 billion. The joint venture is exploring the possibility of building a second fibre line at the Veracel site.

– **Arapoti, Brazil:** Stora Enso acquired Arapoti in August 2006 and became the sole producer of coated mechanical paper in Latin America. The acquisition includes a paper mill producing coated mechanical paper (205,000t/annum), a sawmill (150,000 m^3/annum) and 50,000 ha of land, of which about 28,000 ha are planted. *Pinus* are grown on 25,000 ha and *Eucalyptus* on 3,000 ha.

– Additionally, Stora Enso owns 46,000 ha of land in Rio Grande do Sul, Brazil and 30,000 ha in Uruguay for which plantations are planned and have started. Some 5,000 ha of *Eucalyptus* were planted in Rio Grande do Sul and 4,600 ha of *Pinus* (pine) in Uruguay in 2006.

– The Guangxi plantations in China were started in 2002 and currently consist of about 44,000 ha *Eucalyptus* plantations.

– Stora Enso is also running a small trial plantation (1,200 ha) in Thailand (Thai Stora Enso Agroforestry Co) of mainly *Eucalyptus* and *Acacia* managed for research, development and extension (with no industrial significance)

The highly competitive pulpwood from fast-growing plantations makes South America a key growth area for Stora Enso. In addition to production and plantation units, the Group has four sales offices in the region (in Brazil, Mexico, Chile and Argentina) and a divisional headquarters in São Paulo, Braz

Development of operations in Latin America

- 1997: Veracel joint venture (Bahia, Brazil)
- 2005: Veracel Pulp Mill start up
- 2005: First purchases of land in Rio Grande do Sul, Brazil and in Uruguay
- 2006: Acquisition of a light weight coated paper mill in Arapoti, Brazil

Figure 1: **Approximate location of the Stora Enso plantation landscape in Brazil**

Planned project activities

The project aims to create a sustainable supply of high quality pulp wood in a part of the world where production costs are still comparatively low.

The operation is partly managed from the Stora-Enso office in Porto Alegre, Brazil, along with a similar project in Rio Grande do Sul, although the Uruguay operation is managed on a day-to-day basis from offices in Durazno and Montevideo. It is intended to separate the two operations at some stage in the future, if this happens management will be solely within Uruguay.

The final plantation estate is intended to cover around 150,000 hectares and will be mainly of eucalyptus and pine at a ratio of 4:1.

The final plantation estate is intended to cover around 118,000 hectares of actual plantation, including from land owned by the company and outsourced supplies. The company is looking to purchase around 154,000 hectares. Under current proposals plantations will be mainly of Eucalyptus (*Eucalyptus dunnii* and *E. grandis*) and pine (*Pinus taeda*) at a ratio of 4:1, although this proportion has not been finally decided. If pine were to replace eucalyptus as the dominant species used, this would have implications on the area planted.

The company plans to plant 13,000 hectares per year in Uruguay in the establishment period after an initial planting of 5,000 hectares during 2006, the first year of operation. Most planting will be on company-owned land (currently plans are that a maximum of 80 per cent of trees should come from land owned by Stora Enso) and there is currently an active land purchasing programme. Around a fifth will come from out-grower schemes, buying logs from local land-owners under contract, and it is possible that this proportion could increase in the future.

The final plantation estate will therefore be made up of separate holdings of various sizes scattered across the whole plantation landscape and with a network of public roads and railroad used to transport logs to their eventual destination. This model – both scattered holdings and an accompanying outgrower scheme – has been used successfully in other plantation projects in Uruguay.

The plantation system will be intensive, aiming at a rapid (7-8 year) growth cycle for eucalyptus and 14-15 years for pine. The overall objective of the project is to establish a raw-material base for a future pulp mill somewhere within the plantation landscape and the location studies to identify the most suitable site are ongoing. However no investment decision concerning the mill has been made as yet. The first prerequisite for the investment decision is the successful establishment of the necessary plantation base, which will take in any case some years. In addition several other factors will affect the future decision making including amongst others the overall cost of fibre and prevailing market conditions

Stora-Enso sustainability policy

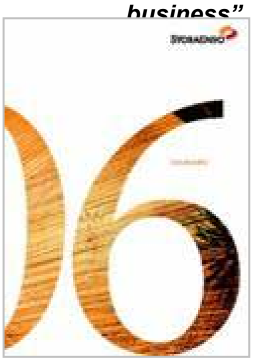
Stora Enso has made a company-wide commitment to a sustainability agenda. The current report is a contribution to this process.

The **Sustainability Committee** is one of Stora Enso's operative committees; its chairman has overall responsibility for sustainability issues. Operational management is responsible for sustainability performance at each organisational level, to guarantee compliance with the Group's commitments. The Sustainability Committee has four support teams:

- ✓ Environment Co-ordination Team (including a Climate Change Steering Group)
- ✓ Customer Support Team
- ✓ Corporate Social Responsibility Team
- ✓ Forest Environment Team (including a Forest Environment Plantations Team)

The group's attitude to sustainability is outlined in the following statement (Anon undated a): "Stora Enso is committed to sustainability – economic, environmental and social responsibility underpins our thinking and our approach to every aspect of doing business. The Group builds accountability into its operations by being transparent and engaging in open dialogue with stakeholders. Group-wide targets and clear governance are used to monitor and measure how well Stora Enso performs in terms of sustainability". This is part of a wider commitment outlined in a *Code of Ethics* statement (Härmälä 2006) quoted below:

"Stora Enso is committed to sustainability – economic, environmental and social responsibility underpins our thinking and our approach to every aspect of doing business"



Box: Extract from the Stora Enso Code of Ethics statement

Stora Enso is committed to sustainable business practices. Sustainability is one of the Group's key success factors, and is seen as inseparable from good corporate governance. Stora Enso expects that its management and employees follow ethical principles in their work. This statement sets out a code of fair and ethical conduct to be followed by the management and employees of the Group. **Stora Enso's Code of Ethics is based on policies and principles established by Stora Enso's Sustainability management.** The principles and practices referred to in this Code of Ethics statement are found in the following documents:

- ✓ Stora Enso Corporate Governance
- ✓ Stora Enso Communications Policy and Principles
- ✓ Stora Enso Electronic Communications Media Policy
- ✓ Stora Enso Financial Code of Ethics
- ✓ Stora Enso Anti-Fraud Policy
- ✓ **Stora Enso's Sustainability Policy**
- ✓ **Stora Enso Corporate Social Responsibility Principles**
- ✓ Stora Enso Occupational Health and Safety Policy
- ✓ Stora Enso Competition Law Compliance Programme

The management of Stora Enso will be responsible for monitoring and enforcing these policies. Any violation of these polices, principles and guidelines will be closely examined, and the necessary action will be taken. [*Our emphasis*]

Further quotations from the company's sustainability report explain how the commitment to sustainability is applied in practice [our emphasis].

“Management systems in the areas of environment, forestry, occupational health and safety and social responsibility help units to recognise the most important sustainability aspects of their operations, develop action plans and follow-up on performance on a regular basis.

“Stora Enso has established sustainability due diligence procedures, which are used in mergers, acquisitions and divestments, to identify and mitigate possible risks. ***Greenfield projects must additionally undergo environmental and social impact assessments***. Sustainability is an essential part of Stora Enso’s risk management. Potential risks related to sustainability could result in material or reputational damage if not pro-actively managed.”

Forest certification

Forest certification is a process whereby an independent auditor assesses performance of forest management against an agreed set of criteria and, if the operation passes, awards a certificate of assurance. A number of forest certification schemes exist with different standards and approaches. Stora Enso has traceability systems in place for all its wood fibre and pulp, 90 per cent of which are third party certified. In addition, 55 per cent of the wood fibre used by the group comes from certified forests (with or without chain of custody certification). Stora Enso “promotes forest certification and aims globally to increase the volumes of wood originating from third-party certified forests.” It works with more than one forest certification system including PEFC, FSC, SFI, CSA, ATFS and CERFLOR (Grönroos 2007). Stora Enso is also committed to certification of the operations in Uruguay, but that this will not take place immediately and the actual certification system has yet to be selected.

“Forest certification is a process whereby an independent auditor assesses performance of forest management against an agreed set of criteria and, if the operation passes, awards a certificate of assurance”.

Some further principles related to forest certification and plantations management (Anon, undated b) are outlined below and overleaf.

Stora Enso's principles for the development of forest certification

I. Credible forest certification systems must:

- ✓ Take into account national and regional characteristics such as natural conditions, forest ownership structures and legislation, to ensure they are widely applicable
- ✓ Formulate certification criteria through open stakeholder dialogue.
- ✓ Include social, economic and environmental aspects in criteria.
- ✓ Promote continuous improvements, through procedures similar to those used in Environmental Management Systems.
- ✓ Require independent third party audits.

II. Stora Enso supports the mutual recognition of credible forest certification systems

III. Forest certification systems should complement the environmental and quality management systems used in wood procurement.

Stora Enso's principles for plantations

Stora Enso's tree plantations are intensively managed, primarily for specific commercial purposes. In our view, sustainably managed plantations are economically profitable, enhance local welfare and have an important role in the conservation of native ecosystems.

- ✓ We recognize the increasingly significant role of tree plantations in global industrial wood production and actively promote sustainable plantation development.
- ✓ We apply a holistic approach in establishment, development and management of tree plantations.
- ✓ We design and manage plantations in a landscape context by recognizing them as part of local land use.
- ✓ We do not convert natural forests, protected areas or areas in the official process of designation for protection into plantations unless that is clearly in line with the conservation regulations.
- ✓ We recognize indigenous peoples' legitimate rights to traditional land and land use.
- ✓ We use environmental and social impact assessments and other participatory tools in seeking sound land-use decisions.
- ✓ We consider an open dialogue with all stakeholders as fundamental.

Plantations in a global context

The following section puts the proposals from Uruguay into a broader perspective, looking first at the history of and debates about plantations in general and then summarising the main questions relating to environmental, social and economic impacts.

Plantations are controversial: the fact that this study is taking place at all is an indication in itself. A similar sized agricultural development (which would probably result in much more profound changes at least from an environmental perspective) would attract far less attention. The first main part of the report therefore seeks to identify the key areas where concern is likely to be raised, analyse the facts about them as known at the present, and try to draw some general conclusions for the operation in Uruguay.

The section immediately below provides a background, by examining the history of plantations and particularly of the plantations debate. This section (pages 24-30) is therefore not an overview of the current state of knowledge but a survey of how perceptions have changed over time. It makes no comment on the accuracy of any statements made – positive or negative – about plantations at this stage. The two sections immediately following look at some of the key areas of concern from environmenta and social perspectives and assess the extent to which such concern is justified and whether it is likely to be an issue in Uruguay. The emphasis here is on identifying relative strengths and weaknesses, but perhaps with a particular emphasis on weaknesses because these are the issues that Stora Enso will need to address first in its own plans..

History of tree plantations

Trees have been planted for millennia. The longest continual written records of a forest management unit dates back over two thousand years for forests managed in Japan to provide particular timber species for rebuilding Shinto temples. Fruit trees have been deliberately cultivated for even longer; for example olives have been cultivated for at least 5000 years (Perlin 1989). Over the centuries, management approaches have evolved, until the 20th century when the type of evenly-spaced, single species forest stands that most people recognise as "plantations" started to become more common. Many of these were set up initially to provide either environmental services such as soil stabilisation or slope control, or to build up strategic timber supplies. They were located mainly on state-owned land and supported by government funds or tax breaks.

In the United Kingdom, intensive plantations emerged as a state policy following the First World War to build up strategic timber supplies, using exotic species and often established on compulsorily-purchased land.

Sitka spruce plantation in Wales Nigel Dudley

Within plantations two factors have altered quite dramatically over the last couple of decades:

Over the past two decades, a proportion of plantations have been managed far more intensively, leading to increases in productivity. At the same time, there has been a shift from public to private sector in terms of both finance and control

- ✓ **A rapid intensification of management and output**: including changes to aspects of: (1) composition including species selection and breeding with growing use of clonal varieties and considerable pressure to introduce genetically modified trees (Strauss et al 2001); (2) approaches to management, particularly increased use of agrochemical inputs and the degree of mechanisation; (3) scale and density of planting; and (4) a resulting increase in productivity. This has led to the recognition of a new form of **fast-wood plantation** (Cossalter and Pye-Smith 2003), with rotation times as short as 5-6 years and almost double the productivity of even those softwood plantations that have until recently been regarded as intensively-managed.

- ✓ **A shift from public to private sector**: until the 1980s, global tree planting was still dominated by states and even most of the emerging fast wood plantations were financed by grants (both from within the country of planting and from donor agencies) and various concessions and tax breaks. Despite some recent changes most forests around the world are still controlled by governments (White and Martin 2002); however in terms of production private investment has controlled an increasingly important proportion of the global market, focusing particularly on those plantations fast rotation and returns on investment (Garforth and Mayers, 2005).

These two trends are linked. In the past, the rate of return from tree production was too slow to attract much private capital unless trees were used as a way of "storing" money in the medium term. Most plantations were developed using a variety of state-based incentives varying from direct grants through various forms of tax breaks. Although this tendency remains, the much more rapid return from fast wood plantations has made it far easier to attract private investment into forest development. While these fast-growing forests are still an almost insignificant proportion of the global forest estate in terms of the land that they cover, they provide a disproportionate amount of the industrial timber and interest in them is growing fast.

The largest plantation estates are found in China, the United States, the Russian Federation, India and Japan, which each have 10 million hectares or more planted, but very little of this is highly intensive. Fast wood plantations tend to be in developing countries and in the tropics or semi-tropics.

We still know far less about the impacts and long-term sustainability of fast wood plantations than we do about other plantations

It is important to separate the much shorter history of privately-owned, intensively-managed fast wood forest plantations from the long experience of traditional tree planting (resulting sometimes in forests that it would take a specialist to distinguish from a natural forest) and even from other forms of relatvely intensive plantations. The most intense forest plantations run continuously, with the process of felling and cutting logs taking place 24 hours a day; new areas constantly being planted or replanted; and tree nurseries preparing cloned seedlings under rigidly controlled conditions. We know less about the impacts and sustainability of fast wood plantations than about other plantations.

Definitions

Opinions about when a forest is more properly defined as a plantation differ and this causes statistical problems as not everyone is measuring the same thing. The UN Forest Resource Assessment, run by FAO and the UN Economic Commission for Europe, has carried out a lengthy process to agree definitions of the term "plantation". The latest version, used as a standard in the Global Forest Assessment in 2000, is: "*Forest stands established by planting or/and seeding in* *the process of afforestation or reforestation. They are either of introduced species (all planted stands), or intensively managed stands of indigenous species, which meet all the following criteria: one or two species at planting, even age class, regular spacing*" (FAO 1998). This is quite constraining, it means that many planted and intensively-managed forests do not "qualify" as plantations – e.g. many Scandinavian forests are replenished through natural regeneration by leaving seed trees and scarifying the soil, which would not qualify as a plantation.

At the other extreme, the more intensive form of plantations, known variously as ***Intensively Managed Planted Forests*** (Kanowski 2005) and ***Fast Wood Plantations*** (Cossalter and Pye-Smith 2003) are now increasingly being recognised as forming a distinct subset of the plantation estate, although this has yet to be distinguished in official data sets or even have an agreed definition. The precise cut-of point is unclear: one analysis proposes a minimum productivity of 14 m^3 per hectare per year for a planted forest to be categorised as a fast wood plantation (James and del Lugo 2005) although Cossalter and Pye-Smith (2003) include species with slower growth rates amongst their fast wood survey.

History and rapid growth

A modern phase of establishing plantations, as they are described in the FAO definition above, started in the first half of the twentieth century, particularly in Western Europe, the United States, Australia, New Zealand and South Africa. During the 1950s major planting efforts spread to Japan, South Korea and China. During the 1960s increased planting also took place in the tropics, with plantation area tripling in size between 1965 and 1980. This process has continued into the new century. Three phases can be identified in the development of intensive plantations (adapted from Kanowski 2005):

- ✓ **First generation temperate softwoods**: from the 1920s onwards and concentrating on temperate softwoods, mainly pines, with a 25-45 year rotation – roughly half the established plantations are in the United States and most of the rest in the southern hemisphere in South America, Australia, New Zealand and South Africa.

- ✓ **Second generation tropical hardwoods**: emerging particularly in the last twenty years and based in the tropics, focusing almost exclusively on tropical eucalyptus and acacia with rotation times down as low as five years.

- ✓ **Third generation former waste wood**: inclusion of wood from plantations that are mainly focused on other materials, including particularly rubber, oil palm and coconut. Changes in pulp technology and in the use of fibre in various manufactured panels have allowed these previously discarded timber sources to be utilised.

First generation: temperate softwoods: UK

Second generation: tropical hardwoods: Indonesia

Third generation: ex waste wood: oil palm in Malaysia

According to the latest figures from FAO, forest plantations covered 140 million hectares in 2005, making up 3.8 per cent of the total forest area, of which 78 per cent are established primarily for timber and fibre production and 22 per cent primarily for conservation of soil and water. Plantations already supply a third of industrial timber and FAO estimates that this will increase to half by 2040 (FAO 2001). Plantations also supply 10 per cent of fuelwood (Commonwealth of Australia 1999) and there are continuing efforts to establish small-scale woodlots for energy supply - such areas fall outside our analysis here.

Between 2000 and 2005 the area of forest plantations has increased by about 2.8 million hectares per year (FAO 2005). Global estimations of the total differ considerably depending in part on the precise definition of plantation (for instance in the 2000 version of the Forest Resource Assessment FAO itself estimated that there were already 187 million ha of plantations (FAO 2001), although it seems as if this has since been substantially modified downwards). Whatever the total, increase has been extremely rapid, from a negligible amount of plantations at the beginning of the twentieth century and still only 17.8 million hectares as recently as 1980: total area has increased by seven times in 25 years (ibid).

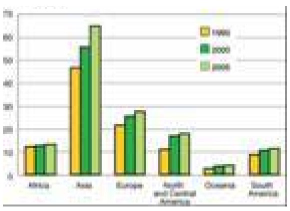
"Fast wood plantations make up … perhaps 15 per cent of the current plantations"

Fast wood plantations make up a much smaller fraction of the total. Kanowski (2005) estimates perhaps 15 per cent of the current plantations qualify as intensively-managed while Cossalter and Pye-Smith estimated a lower total of 10 million hectares in 2003 with over 70 per cent consisting of tropical or temperate eucalyptus, plus various pines, *Gmelina arborea*, *Paraserianthes falcataria* and poplars. However, the proportion of fast wood plantations looks set to continue to increase.

The growing debate

Fast wood plantations avoid one of the constraints that have often reduced the flow of private money into forestry; namely the long lead time to repay investment. Rotation times of a few years coupled with high productivity have changed many investors' attitudes to plantations in less than a decade. But at the same time debate about the worth of plantations has intensified. Many previous discussions and guidelines about plantation management no longer seem relevant. For example in 1993 the International Tropical Timber Organisation was recommending in its guidelines on planted forests that "Whever possible and feasible, (the) second generation should be planned to become more complex and diverse" (ITTO 1993) and paid comparatively little attention to the concept of continuous monoculture plantations.

Changes in plantation area 1990-2005 (million ha)



From FAO 2005

An "International Experts' Meeting on the Role of Planted Forests in Sustainable Forest Management", held in Chile in 1999 under the auspices of the Intergovernmental Forum on Forests, agreed that all sustainable forest management (SFM) principles should be met at a national level, but there was disagreement about the extent to which all SFM objectives should be met at landscape or stand scale (Anon 1999) – i.e. there was debate about the extent to which plantations should follow the standards for sustainable forest management being developed at that time through initiatives such as the Ministerial Conference on the Protection of Forests in Europe (MCPFE 2003) and the Montreal Process (1999). This debate remains ongoing to some extent.

Plantations debate and reforms

Initial welcoming of plantations was based around concerns to develop a rapid response to deforestation and energy shortages

Drakensberg, South Africa: Nigel Dudley

Plantations have become the subject of a sustained debate between human rights organisations, environmental groups, governments and industry, sometimes catching forest management companies unprepared for the scale of reactions that they can produce. This has not always been the case, and attitudes to fast wood plantations have developed through three distinct phases amongst environmental and social NGOs, and to some extent also academics (Dudley et al, 1997):

- ✓ **Initial welcoming**: with plantations seen as a response to the social and environmental impacts of forest loss and degradation
- ✓ **Growing criticism**: particularly of large-scale plantations on social, environmental, aesthetic and economic grounds
- ✓ **Efforts at improvement**: acceptance of the concept of fast-growing tree crops and attempts to influence policy on location and management to minimise detrimental side effects

The second and third of these strands are still running simultaneously; with entrenched opposition from some critics and active participation by others, a situation that is itself leading to tensions within the NGO community.

Initial welcome for plantations

Early concerns about forest loss included a strong element of social concern, in particular regarding a perceived "fuelwood crisis" (e.g. Eckholm, 1975). Although some of these fears proved exaggerated (Leach and Mearns, 1988) they encouraged the new "environmental movement" to argue for rapid replanting particularly in areas where poor people were reliant almost entirely on wood supply for their energy needs. These concerns were further heightened by alarming reports about the rate of tropical forest loss (Myers, 1979). In the 1970s, proposals for replanting often included both large and small plantations (e.g. Weber 1977, Smith 1981) and were supported by groups such as Friends of the Earth and Greenpeace. Think tanks and research institutes pointed to options for using fast-growing timber for energy (e.g. Eckholm et al, 1984; Miller et al, 1986) although in most cases these focused on small-scale and community-owned plantations. Interest in biomass as a future energy source focused mainly on faster-growing plants such as sugar beet although this situation is now changing.

Growing criticism of plantations

By the late 1980s early enthusiasm for plantations was replaced by growing criticism from a variety of social and environmental NGOs

By the late 1980s, early enthusiasm for (or at least neutrality towards) plantations was being replaced by growing criticism from a variety of social and environmental NGOs. Initial concerns surfaced in Europe and focused on aesthetics, with amenity groups criticising plantations for their visual appearance and for blocking access to open country (Tompkins, 1986), as in the Flows Country of north-east Scotland (Stroud et al, undated). Later, criticisms of the grant schemes supporting *Eucalyptus* plantations grew in Mediterranean Europe (Dudley 1992). This unease broadened, with studies claiming that plantations were a net cause of forest loss in countries like Indonesia, because natural forest was being cleared to provide space for planting fast crowing *Acacia* or *Eucalyptus* (Down to Earth, 1991). Problems were also identified with respect to a decline in forest quality in temperate and boreal regions as natural forests were replaced by intensive plantations, which had fewer values for wildlife, recreation or in some cases environmental services (Dudley, 1992; Dudley at al, 1995; Watkins, 1993).

An associated debate sprang up about pulp mills. Criticism focused on the impact that effluents had on aquatic life (Södergren, 1988) and human health (Kroesa, 1990) and eventually led to changes in pulp mill technology. This debate is still active in Latin America and was intensified in 2005 by a serious poisoning incident of a Ramsar site (a conserved wetland area) in Chile. One manifestation of the tension is blockades and political tensions between Argentina and Uruguay about a pulp mill being built in Fray Bentos, southern Uruguay, from 2005 to the present.

The pulp mill under construction at Fray Bentos, Uruguay, has become the focus for unprecedented protests from Argentina, which have gone as far as the International Court in The Hague

.

Nigel Dudley

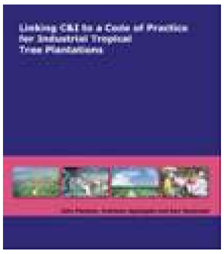
Simultaneously, social-welfare organisations questioned the impacts of plantation establishment on local communities, particularly regarding loss of human rights (Carrere and Lohmann, 1996) and disruption to employment (Carrere, 1999). The social and economic impacts of intensive forestry were assessed by donor organisations, including FINNIDA (Hisham et al, 1991). A particular issue of concern related to land tenure, with accusations that governments in some countries were selling concessions in areas that included the traditional homes of indigenous peoples, or where settlers had established communities.

The debate about plantations has focused on large, monoculture plantations. Few people have criticised the use of small village woodlots or farm crops, whatever species are chosen and some research suggests that small scale plantations engender less conflict (e.g. Schirmer 2007).

Responses

A series of governmental and non-governmental initiatives examined the issues and proposed ways forward. Within the United Nations, the Intergovernmental Forum on Forests (now known as the UN Forum on Forests) developed a study on the *Global Outlook for Plantations*, hosted by the government of Australia (Commonwealth of Australia, 1999) and held an experts' meeting in Chile in 1999 (Anon, 1999). These efforts were boycotted by some NGOs because they were seen as being biased towards plantations and the industry. The International Institute for Environment and Development in London prepared a major study on the pulp and paper industry for the World Business Council on Sustainable Development (Grieg-Gran, 1996). The Center for International Forestry Research (CIFOR) published a review of fast wood forestry that sought to present a balance between the two points of view (Cossalter and Pye-Smith, 2003).

Some environmental groups also started to engage with the plantations industry (e.g. Elliott 1999). In what amounted to a major change in policy, the Forest Stewardship Council (FSC), which was originally set up to certify natural forest management, developed certification systems for plantations and many environmental and social NGOs engaged in this process. This is now currently under review, although the principle of certifying plantations remain and almost all tropical FSC certifications focus on plantations. Most other certification bodies, such as the PEFC, work with plantations, as does the ISO-14000 series of



There have been a number of attempts at setting best pracice

environmental standards. FSC certification of plantations has drawn criticism from some NGOs including the World Rainforest Movement (Carrere, 2006) and the Rainforest Foundation (Counsell and Loraas, 2002). Other NGOs, including WWF, have worked closely with companies involved in plantations. Opinion about when and if plantations are a positive aspect of forest management is still debated even within some of the NGOs that are actively working on plantation issues.

At the same time, many stakeholders have worked at developing best practice guidelines and models for plantations including FAO, CIFOR and many individual countries or regions (see section 1.11 for a summary and analysis of these).

The debate has by no means concluded and positions are still shifting; some NGOs that were originally supportive of the FSC for example are now more reluctant to be involved while in other cases former opponents of plantations have tempered their opposition.

Potential environmental impacts of plantations

Plantations can stimulate changes in the environment, with the net results depending mainly on where they are planted and how they are managed. ***The following section*** (31-54) ***focuses primarily on potential negative impacts***, by identifying the key issues of concerns raised by scientists, environmental NGOs and communities (see Table 2 below) and then analysing each in turn to assess whether (1) the concerns are real according to our current state of knowledge and (2) if so, are likely to be important in Uruguay. Note that Table 2 is a qualitative listing of issues without references or comment: discussion in the sections following makes full reference to existing published literature.

Table 2: **Key areas of concern relating to the environmental impacts of plantations**

Issue	Notes
Water quantity	***Key concern*: plantations could result in reduced availability of water elsewhere in the catchment**. Planting pine and *Eucalyptus*, is said to result in reduced surface flow and/or groundwater recharge, especially if these are planted in recharge areas or near water courses. Sometimes this is claimed as a benefit – e.g. to reduce salinisation – in other cases it is claimed that plantations have led to net reduction in water flow to nearby areas.
Water quality	***Key concern*: plantations could increase soil erosion and use of agrochemicals, both leading to reduced water quality**. It is claimed that badly managed drainage, ploughing and clearfelling can increase water turbidity, which can damage breeding success of fish and disturb aquatic life. It is also claimed conversely that plantations can stabilise soil, thus reducing runoff and improving water quality. In sulphur and nitrogen polluted air on base-poor soils, plantations are said to increase soil/water acidification by trees “trapping pollutants” from the air.
* Soil	***Key concern*: soil erosion could increase and more soil will was into watercourses**. Plantations are said to stabilise soil in areas where erosion has been a problem. Conversely it is claimed that deep ploughing and use of heavy machinery can lead to erosion and nutrient loss as can clearfelling.
* Agrochemical use	***Key concern*: use of fertilizers and various forms of herbicide and pesticide could damage non-target organisms**. Three main concerns are raised: about leaching of nitrae and other fertilizer into water, impacts of herbicides used to clear vegetation and impacts of various pesticides.
Biodiversity	***Key concern*: plantations could replace natural and / or semi-natural habitats and thus result in a major reduction in biodiversity**. The major environmental criticism in many regions relates to replacement of a biodiversity-rich native habitat with a monoculture plantation of low value to wild nature. Conversely it is argued that plantations often have a richer biodiversity than land they replace if the latter is degraded.
* Introduction of exotic species	***Key concern*: plantation trees or other introduced species could spread into surrounding areas**. The impact of invasive species is becoming a major international concern. Key concerns here are whether the trees themselves can spread and compete with native vegetation and whether they could also result in the introduction of other invasive species (e.g. weed species, exotic pest invertebrates or fungi).
Changes to the fire ecology	***Key concern*: damaging fires could increase**. Plantations are said to sometimes increase fire risk through poor management or drying of surface water or in other cases result in artificial suppression of fires due to management practices, leading to less frequent, hotter fires.
Changes to soil fertility	***Key concern*: soil fertility could decrease**. Some early plantations declined after the first rotation and there have been concerns that plantations may not be viable over time.

One challenge in identifying possible causes and effects of plantation developments is in distinguishing the types of plantation used for particular studies. While the species planted is generally identified, many research reports and journal articles are not precise about rotation times, management methods and level of inputs, making it difficult to tell wihether a plantation would qualify as “fast wood” of not. In some cases this makes comparatively little diference, for example in terms of land-use implications, species choice or the effect of individual harvesting operations. On the other hand, water use and agrochemical use for instance might be perceptibly different, as will many of the employment implications. Whenever possible the latest information relating to modern intensive plantations is used, or where the only information relates to older plantations this is where relevant made clear.

Plantations and water quantity

Key concern: plantations might reduce net water availability.

It is now generally agreed that net water flow under trees is reduced compared to most other land uses, including pasture

Do plantations reduce water availability?

It is now agreed that net water flow under trees is generally reduced compared to most other land uses, including pasture. This tendency has been recognised for almost 40 years (Swank and Helvey 1970); a compilation of results from 94 paired catchments found that afforestation always reduces water outflow (Bosch and Hewlett 1982) and a study of changes over 40 years in catchments in South Africa (van Wyke 1987) suggested that percentage of area afforested, total biomass and rainfall all appear to have influenced the magnitude of streamflow reduction. Although most work has been carried out in Australia, South Africa and the United States, studies from as far away as Thailand (Chomitz and Kumari 1996), New Zealand (Fahey 1994) and Fiji (Gregersen et al 1987) found a similar pattern. The same is true in Brazil, in similar ecological conditions to Uruguay, where research found that plantations reduce the drainage from a basin with impact affected by the total amount of plantations in the landscape (De Paula Lima and Zakia 2006). Exceptions occur, including a possible increase in dry season run-off, but the latter is commonest in cloud forest and semi-arid regions (Calder 2002). Several overviews have been prepared to summarise understanding (e.g. Keenan et al 2006; O'Laughlin and Nambiar 2001).

"Different site-specific and often competing processes may be operating and the direction – let alone the magnitude of the impacts – may be difficult to predict for a particular site" – Prof. Ian Calder

An analysis of 26 catchment data sets, with 504 observations, was carried out by Farley et al (2005), including annual runoff and low flow. They found annual runoff was reduced on average by 44 per cent (+/- 3 per cent) and 31 per cent (+/- 2 per cent) when grasslands and shrublands were afforested respectively. In this study *Eucalyptus* had a larger impact than other tree species in afforested grasslands reducing runoff by 90 per cent (+/- 10 per cent) compared with a 40 per cent (+/- 3 per cent) average decrease with pines. For grasslands, absolute reductions in annual runoff were greatest at wetter sites, but proportional reductions were significantly larger in drier sites.

Keenan et al (2004) write: "Over large regions with year-to-year stable vegetation, water use by forests of all types is higher than areas covered by pastures or crops. This is because forests carry a higher leaf area and have deeper roots. They intercept more rainfall and evapotranspiration is higher. Leaf shape, surface texture and arrangement affect interception". Impacts cannot be generalized. Professor Ian Calder (2002) outlines the problems: "Different site-specific and often competing processes may be operating and the direction – let alone the magnitude of the impacts – may be difficult to predict for a particular site".

Nonetheless, many attempts have been made to model run-off. For example, in 1987, Kuczera developed a model for catchment yield following growth of *Eucalyptus regnans*, which suggested that water was reduced most when trees were young and that the catchment in this case gradually started to recover hydrological equilibrium after about 12 years (See Figure 2 overleaf). This was backed by catchment research by Vertessey et al in 2001 which showed that water yield from an old-growth stand of *Eucalyptus reglans* is double that of 25 year-old trees.

Increased water use by eucalypts is partly due to increased evaporation and interception as compared with short vegetation (although interception losses are likely to be less than with some other tree species) (Calder (1992).

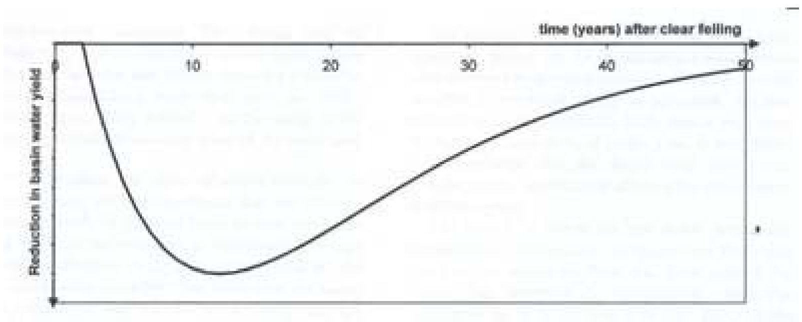


Figure 2: **A generalized model trend of catchment streamflow reduction as a result of the growth of the forest regenerated after the forest fire** (Kuczera, 1987)

Vertessey (2000) argued that run-off was reduced most under wet conditions. This was confirmed by Zhang et al (2001) using data from over 250 experimental catchments worldwide to model mean annual evapotranspiration at the catchment scale against rainfall, potential evapotranspiration and soil available water capacity. However, Farlet at al (2005) found proportional reductions were significantly greater for drier sites.

Research in Australia found that for conditions in the country, differences are undetectable when annual rainfall is less than 500 mm. When annual rainfall is 1,500 mm, difference is greater than 200 mm (Keenan et al 2004). In the most comprehensive review to date referred to above, analysis by Jackson et al (2005) showed an average decrease of 227 mm per year in streamflow (in 52 per cent of the catchments studied), and complete drying up of streams in 13 per cent of catchments. Studies of *Eucalyptus grandis* in South Africa found that streamflow disappeared after nine years and only returned five years after harvesting (Scott and Lesch 1997). Measurement of changes in annual flow duration curves in catchments in Australia, New Zealand and South Africa found that changes in flow regime were variable, with two responses identified: (1) a substantial increase in the number of zero flow days, with low flows being more affected than high flows and (2) catchments showing a more uniform reduction in flows across all percentiles (Lane et al 2005).

These impacts appear to be because of the rapid growth of eucalyptus and research suggests that for each cubic metre produced eucalyptus is not a larger water user than other species (De Paula Lima and Zakia 2006, Stape et al 2004a).

Another potential impact is a net reduction in rate of groundwater recharge, either because trees intercept more of the water or because their roots reach shallow groundwater resources. This seems to be particularly the case with eucalyptus (Calder 1992). For example blue gum (*Eucalyptus globulus*) has been shown to reduce groundwater in South-West Australia (Harper et al 2000). Research in South-east Australia found significant groundwater use in some experimental *Eucalyptus* plots, which also had the highest growth rates (Benyon and Doody 2004). Calder et al (1992) write: ‘‘When eucalyptus is planted in areas where the roots have access to groundwater, as for example when planted next to irrigation canals, there is no doubt that growth rates are higher by a factor of at least five, and that water consumption is likely to be roughly commensurate.’’

In these cases there may be no visible signs that hydrology is being impacted on the land surface but nonetheless changes can be taking place to long-term water reserves. It is noticeable that in the case of both direct impacts on surface water and, to an even greater extent, impacts on recharge of ground water, there may be a long lag time between plantation establishment and measurable changes (Scott

2005). Conversely, some hydrological effects of forest management, such as clearfelling, may be apparent almost immediately (O'Laughlin and Nambiar 2001).

Different tree species have differing impacts on water and water interception can also vary dramatically *within* a species depending on factors such as water availability, climate and density of planting (Hall 2003). Despite the debate about water and eucalyptus, most research suggests that pines actually intercept more water. An evaluation of 145 catchments experiments indicated a 20-25 mm reduction in outflow at a 10 per cent increase in coniferous forest, a 6 mm decrease for eucalypt forest and a 17-19 mm decrease for deciduous forests (Sahin and Hall, 1996). An example of some of these changes in a Brazilian catchment is given in Figure 3 overleaf, comparing changes in water interception for bush, *Pinus caribea* and *Eucalyptus grandis* (from de Paula Lima 2006).

Note: we should get a better copy of this diagram if Walter is happy for it to be used…

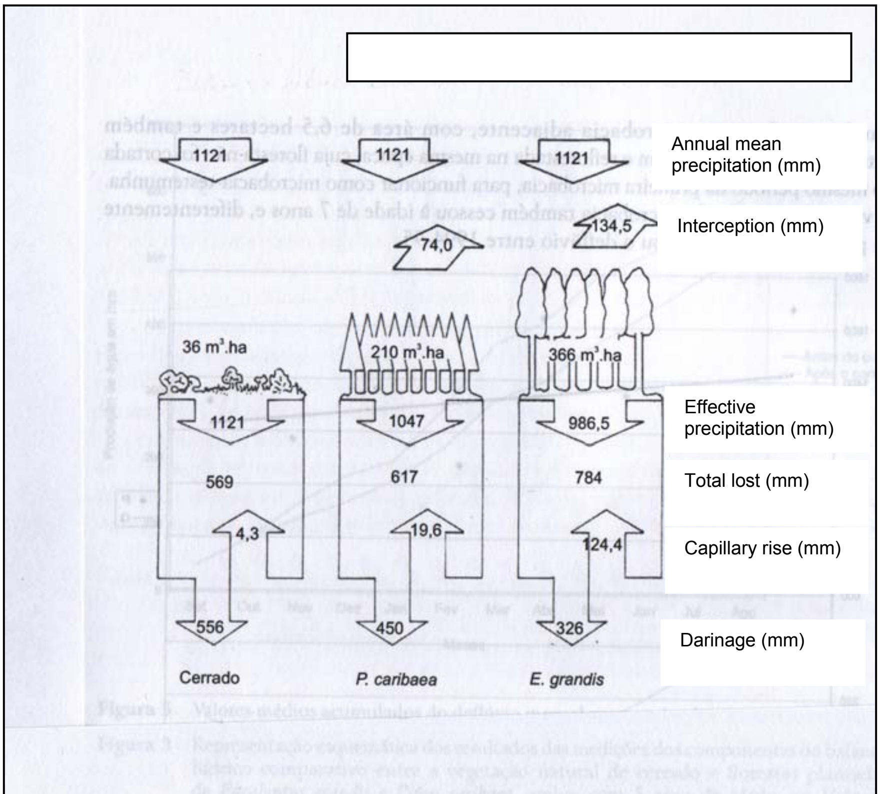


Figure 3: **Example of differences in interception of water under different land management regimes (from De Paula Lima and Zakia 2006)**

Factors affecting water flow

The extent to which plantations intercept water is therefore affected by a range of factors relating to climate, geography and management; some key variables are summarised in Table 3 below.

Table 3: **Factors affecting changes in water interception as a result of plantation establishment**

Variable	Details	Source
Climate		
Rainfall	Generally the proportion of water lost is highest under wet conditions	Vertessey 2000 Zhang et al 2001
Geography		
Soils and geology	The nature of soils and bedrock have a major impact on rate of water movement and thus groundwater recharge	Keenan et al 2004

Variable	Details	Source
Depth of water table	Some plantation species, including many eucalypts, can draw water directly from shallow groundwater source	Keenan et al 2004
Nature of water flows	Factors such as the number of streams, degree of slope, presence of wetlands and extent to which soils and vegetation retain water will all have impacts on water removal by trees, which will change depending on the particular site.	Calder 2002
Management		
Percentage of trees in the landscape	Impacts are affected by total area of trees in a catchment. Research in Australia found anything less than 20 per cent planted will have little measurable impact, but this may not apply in other conditions.	Australian Government Bureau of Rural Sciences 2003; Brown et al 2005
Age classes of trees	Very young trees tend to use less water than older trees	Keenan et al 2004
Density of tree planting in a given area	Water interception will also be affected by how densely trees are planted within a site.	Hall 2003
Rotation time and fallow period	Short rotation times can maintain the watershed in the period of near maximum water use by trees, thus not giving groundwater systems a chance to recover,	De Paula Lima and Zakia 2006
Thinning regime	Removing trees (usually at least 20 per cent of biomass for a noticeable impact) can lead to temporary reduction in water use, although this does not usually have noticeable impacts when water is scarce	Wheeler et al 2002
Proximity to water sources	Trees planted close to streams, rivers and lakes tend to extract greater amounts of water	De Paula Lima and Zakia 2006
Species	Leaf shape etc. Pine generally a greater impact on water than eucalyptus, although a few experiments have found the reverse	Sahin and Hall 1996
Growth rate	The speed of growth also relates directly to the amount of water used	Scott 2005

Due to the complexity of forest-catchment interactions, plantations in many parts of the world are established without certainty about impacts on water. With care and knowledge, in most cases reasonable predictions can nonetheless be made, but for forest managers, there is inevitably a measure of trade off.

"Growing trees quickly, something that is implicit in economically successful plantation forestry, is going to cost water; you cannot have one without the other. In certain places this will cause conflicts"

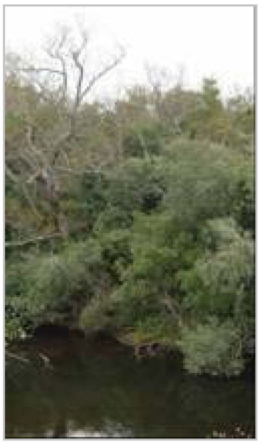
Scott 2005

Scott (2005) sums it up: "Growing trees quickly, something that is implicit in economically successful plantation forestry, is going to cost water; you cannot have one without the other. In certain places this will cause conflicts". The trick is to make the best possible predictions and identify steps to minimize the problems, including planning at both landscape and site scale. Table 4 below outlines some of the factors that need to be taken into consideration.

Table 4: **Scales and hydrological indicators for the maintenance of catchment health, thus contributing for the protection of water values and for the search of sustainable management of planted forests** (modified from Lima & Zakia, 1998)

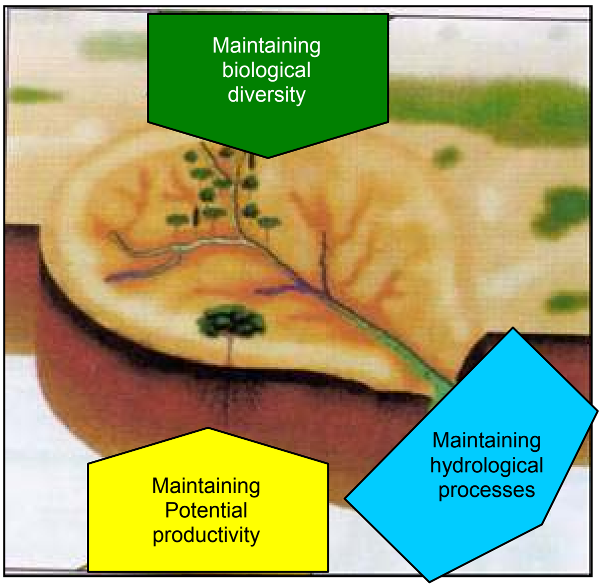
Scale	Water impacts	Possible causes	Indicators	References
Macro	Available water	Afforestation / deforestation	Regional water balance	Versfeld, 1996 Nambiar 1999
	Landscape values and biodiversity	Unplanned, large-scale plantations	Ecological zoning	Hartley 2002 Andreassian 2004

Meso	Catchment degradation	Destruction of riparian ecosystems	Conditions of riparian areas	Dias Jnr et al 1999 Goncalves and Stape (eds.) 2002
		Inadequate roads	Road design	Girvetz and Shilling 2003
		Soil compaction	Infiltration	Boothroyd et al 2004
		Erosion	Soil conservation measures	Pennington and Laffan 2004 Fernandez et al 2004
Micro	Water quantity and streamflow regime	Change in forest cover	Stream discharge	Swank and Miller 1968 Calder 1986
	Eutrophication	Fertilisation, erosion, lack of buffer	Concentration of P and N in stream	Fahey and Jackson 1997 Scott and Lesch 1997
	Stream shoaling	Erosion and sedimentation	Stream turbidity	Huber at al 1998 Sharda et al 1998
	Nutrient losses	Erosion, clearcutting	Stream conductivity, catchment biogeochemistry	Câmara and Lima 1999 Vital et al 1999 Câmara et al 2000 Vertessey et al 2001 Stott et al 2001
	Organic materials	Decomposition of residues in streams	Dissolved oxygen and colour in stream water	Mackensen et al 2003



Riparian zone by river in central Uruguay

Nigel Dudley



More generally, the microbasin provides a useful landscape unit for considering the impacts of overall changes in the catchment and a useful scale at which to balance productivity, biodiversity and water. Figure 4 below, from de Paula Lima and Zakia (2006a) outlines some of the main influences.

Figure 4: **Major impacts on a microbasin**

There is still much to be learnt. Research needs relating to water and plantations, identified by a Plantations and Water Roundtable organized in Australia in 2005 included: "development of methods to assist catchment managers address the competing demands on water in over and under-allocated catchments; comparative studies of the water use efficiency of plantations relative to other agricultural crops, including irrigated and non-irrigated crops; longer term research to transfer data from experimental catchments to large catchments; quantification, at a regional level, of the overall socio-economic impacts of all competing land and water uses; and the impacts of long term climate change on plantation productivity and water yields" (Tree Plantations Australia 2005).

Note the Joggaby paper is a pHD thesis and I've not seen it myself – need to ask Walter

Implications for Uruguay: Much of the information available from grassland areas of Australia, South Africa and elsewhere is applicable to Uruguay although conditions will not be precisely the same. Research in similar habitats in surrounding countries gives additional useful information. For example intensively-managed Eucalyptus in Brazil use 300-600 m^3 of water for every 1 m^3 of wood produced (Stape at al 2004), which is more than grassland though one study suggests it is approximately equal to or less than natural forests (Aracruz 2002, 2003). Afforestation of grasslands by *Eucalyptus camaldulensis* in Argentina lowered the water table by almost a metre and increased salinity to the point where salt sensitive species might experience problems (Joggaby 2002). Some research is currently underway in Uruguay (e.g. Chescheir et al 2004); modelling conversion of pasture with grazing in a basin in Tacuarembo suggests a predicted reduction in annual water yield under *Pinus taeda* of 23 per cent, with a maximum predicted hydrologic effect of 30 per cent reduction in mean annual water yield from the afforested catchment (von Stackelberg et al 2007).

The evidence suggests that water flow from eucalyptus and pine plantations is likely to be less than from the pasture that they replace. The reduction can be influenced by factors such as the proportion of the watershed that is planted, density of planting within a site and how close trees are planted to aquifer recharge areas and other surface waters: these issues are addressed in the section on site planning Although there is enough information available to make clear recommendations about management approaches to minimise impacts on surrounding holdings, it is difficult to predict exactly what will take place in individual cases and monitoring will be necessary to ensure that offsite impacts are minimised.

Plantation and water quality

Key concerns plantations might affect water quality through:

- ✓ Sedimentation of water courses as a result of soil erosion through planting and harvesting practices or from logging roads and tracks
- ✓ Trapping air pollutants, so that these are washed down into water courses
- ✓ Application of fertilisers, herbicides and pesticides in the management of plantations, which may end up in water courses

The first two are addressed below; the third in a separate section following.

- Impacts on soils

Issues such as garbage disposal on the plantation site are important to ensure maintenance of qater quality in nearby rivers and streams.

Losses of soils have implications for the planting site and for surrounding watercourses – both are examined here. Research suggests that poor management practices in plantations can lead to increased soil compaction and erosion and depletion of soil nutrients (Lai 1997), in three main ways:

- ✓ Soils and other particles can be dislodged by heavy machinery and wash into rivers and streams, particularly during harvesting and particularly clear-felling (De Paula Lima and Zakia 2006)

- ✓ Soils that are left bare in between rotations may be more susceptible to erosion and can be washed into water courses, particularly if there are heavy rains (El Swaify, 2002)

- ✓ Poorly designed road systems can increase surface run-off and hence soil erosion (Swanson et al 1997)

The magnitude of impacts is likely to vary. For example long term research in hardwood forests the Upper Appalachians, United States, found that small increases in nutrient load after clearcutting and logging and larger increases following road construction (the latter increases associated with two storm events) (Swank et al 2001).

Conversely, in areas where soil erosion is already a problem, establishing plantations can sometimes help to reduce rates of soil loss and stabilise the surface. Eucalyptus plantations have been used for this purpose in China for example (Jiayu and Sinming 1996) and reforestation was used as a means of reducing avalanches and erosion in many European countries, such as Switzerland (McShane and McShane-Caluzi 1997).

Implications for Uruguay: these issues appear to be most common in areas of steep slopes and high rainfall, neither of which is likely to be the case in the Stora Enso plantations. Nonetheless, the IMS will need to address these issues carefully in management planning, particularly with respect to developing buffer zones, best practice during harvesting (use of brash to reduce soil compaction etc) and timing of operations.

- Impacts from atmospheric pollution

In conditions of high air pollution, some plantation species are also effective at capturing pollutants on their foliage, which is later washed into water-courses (Burden et al 1987). For instance, a study in south west Scotland found a significant rise in surface water acidification in rivers found by pine plantations (Helliwell et al 2001).

Implications for Uruguay: wash down of air pollution is not likely to be a significant problem in the rural areas where Stora Enso is planting.

Plantations and agrochemicals

Key concern: agrochemicals might have detrimental impacts on soils, water and biodiversity.

Fast wood plantations rely to an increasing extent on the use of fertilizers to maintain soil productivity, herbicides to replace hand clearing of vegetation and insecticides, in the case of Uruguay employed mainly against ants.

Fertilizers

Fertilizer stored at Stora-Enso plantation

Research to date suggests that in general nitrogen fertilization in plantation forests is unlikely to have serious side effects on the environment, if managed correctly (Binkley et al 1995). The following review looks particularly at nitrate.

The drinking water quality of forest streams is usually higher than in alternative land uses such as agriculture (Binkley 2001), and for instance a survey of the world's hundred largest cities found that a third relied on forest protected areas for a substantial part of their drinking water supply (Dudley and Stolton 2003). However, addition of fertilizer will create changes. A review published in 1999 (Binkley et al) found that in general peak concentrations of nitrate-N in stream water increased after forest fertilizers were used with a few studies reporting concentrations as high as 10-25 (mg N)/l as nitrate. Increases in average concentration are much lower than the peaks and the highest annual average nitrate-N reported was 4 (mg N)/l as nitrate. In Brazil, the Aracruz watershed project (Aracruz 2002) found that concentrations in groundwater averaged 3 mg N/litre in plantations. Relatively high concentrations tend to occur with repeated fertilization, use of ammonium nitrate rather than urea and fertilizing when nitrate concentrations are already high. No evidence has been reported of detectable changes in composition or productivity of stream communities. However, the authors point out that there are still major limitations in knowledge of effects of repeated fertilisation in short rotation plantations and in tropical ecosystems (Binkley et al) 1999.

High nitrate levels in water causes a range of problems including eutrophication: a burst of algal growth followed by oxygen depletion when algae die and decompose (Stewart and Rosswall 1983; Smith et al 1999). In terms of human health, elevated nitrate levels in drinking water are related to infant methaemoglobinaemia or blue baby syndrome and World Health Organisation (WHO) limits are set to reduce risks of this potentially fatal disease. Methaemoglobinaemia is most likely when a child is weakened and drinking contaminated water. It is a greater risk in under-developed countries (Pretty and Conway 1988), although, WHO limits have een exceeded in developed countries in areas with intensive agriculture, leading to supply of bottled water to nursing mothers (Dudley 1985). Such levels are unlikely to occur from use in forest plantations. Nitrate may also interact with organic compounds to form nitrosamines, which are known to cause cancer, although extensive epidemiological studies in human populations have failed to find evidence that high nitrate levels cause cancer in humans (Forman et al 1985).

Some research suggests that plantation forestry can elevate nitrate levels if sufficient care is not taken in their application. Elliott and Hodgson (2004) analysed 5,227 water samples in Tasmania's plantations over a ten year period. They tested concentrations of herbicides, pesticides and fertilisers applied and compared them to the recommended safe limits according to Tasmanian law. They found that "Most of the operations where guideline levels have been exceeded involved application of nitrogen fertilisers. High readings of nutrients in forest streams can occur due to several factors such as high natural background levels, direct deposition of fertiliser on watercourses, application of fertiliser to saturated soils, and runoff and leaching following significant rainfall after fertilising". These results are mirrored in other countries. For example, studies of plantations in mid-Wales (Chapman et al 1999); in shade grown coffee plantations mixed with *Eucalyptus deglupta* in Costa Rica (Renderos et al 2004) and eucalyptus in the Congo (Neal et al 2004) all found increased nitrate pollution in ground and / or surface water near plantations. Research reported from north Queensland, Australia, found nitrate pollution from pine plantations was leading to pollution in the Great Barrier Reef (Faithful et al 2005). Losses were generally greatest in periods of high rainfall. It has also been suggested that nitrate losses may be proportionately higher in nurseries (Neal et al 2004).

Impact depends on rate of application and factors such as density of tree planting, soil fertility, rainfall patterns and the site fertilisation history (Renderos Durán et al, 2002). Integrated management systems can reduce rates of loss (Croke et al 1999) through matching of needs, timing of applications (both seasonally and to avoid heavy rains) and choice of application method. In particular slow release methods and avoidance of poor weather conditions can both reduce losses.

There are some questions about the importance of fertilizer application. A comparison of 14 fertilized stands of eucalyptus in Brazil found that water tended to be the most limiting factor and higher water supply was also associated with increased use of light and nitrogen. Efficiency of resource use also increased with increasing productivity (Stape et al 2004b).

Implications for Uruguay: research suggests that the levels of fertilizers applied are unlikely to have major offsite effects. However, there may be arguments for using slow release forms of fertilizer and certainly for matching use precisely to the needs of the particular site rather than applying one level for all plantations.

Pesticides

The major use of pesticides within plantations is the application of herbicides to clear vegetation where trees are to be planted; much smaller but potentially more toxic insecticides can also be used particularly to control ants. Use is generally fairly low compared with farming. In Australia for example, plantation forestry accounts for only 0.7 per cent of pesticide use by cost, and 99 per cent of forestry pesticide use is as herbicides with only 1 per cent insecticides. Use is generally only for the first two years of the plantation cycle and most uses are at less than 50 per cent of maximum label rate (Jenkin and Tomkins 2006).

Stora Enso will be replying mainly on glyphosate as a herbicides and various insecticides used against ants, both of which are considered below.

Glyphosate

Glyphosate is generally accepted as being one of the less hazardous herbicides, particularly from the perspective of impacts on the environment.

In 2002, the European Union carried out a review of current information on glyphosate (European Union 2002) which concluded that products containing glyphosate fulfilled the basic safety requirements outlined in Directive 91/414/EEC, i.e.: *"that a) their <u>residues</u> do not have any harmful effects on human or animal health or on groundwater or any unacceptable influence on the environment; and* *(b) that their* *use, does not have any harmful effects on human or animal health or any unacceptable influence on the environment. These conclusions were reached for the following uses: herbicide against terrestrial annual weeds, perennial weeds and shrubs in fruit, vegetables, forestry, grassland, ornamentals and arable crops as well as non-crop uses".* The US Forest service has also published a major study on glyphosate (Durkin 2003) which also concluded that its toxicity is too low for concern. Nonetheless, recent scientific articles in specialised journals seem to raise questions about health impacts on both people and animal species.

Impacts on biodiversity: Over 2,000 journal articles have been published about the impacts of glyphosate on non-target organisms. A major review of published literature on the impacts of glyphosate on non-target plants and animals, primarily in North America, (Guiseppe et al 2006) concluded that: "*In general, the application of glyphosate in forest landscapes to suppress the growth of non-crop deciduous shrubs and trees appears to have limited immediate direct effects on non-target fauna. Long-term negative effects of glyphosate also appear to be limited in scope, although some species are affected. These long-term effects on the animals are most likely caused indirectly by the altered plant community and levels of light penetration*". An analysis of 60 published studies of the impacts of glyphosate on temperate forestry and agro-ecosystems found that species richness and diversity of vascular plants was either unaffected or increased. Small mammal communities appeared little affected; songbirds were generally unaffected although some small species declined temporarily while others increased. Terrestrial invertebrates had variable responses in abundance (Sullivan and Sullivan 2003). This appears to be supported by work in other parts of the world.

…long-term effects on the animals are most likely caused indirectly by the altered plant community and levels of light penetration…

For example, studies in southern Georgia, USA, found no detectable differences in floristic species richness seven years after broadcast pine release treatments (Boyd et al 1995). Research into treatment of plantain crops in cleared secondary forest in the Congo Basin found that weed species were generally susceptible to glyphosate while natural forest species were resistant (Hauser et al 2006). Cryptograms (ferns etc) showed some declines (Newmaster and Bell 2002) and mosses declined initially but had recovered after two years (Lautenschlager and Sullivan 2002).

Small mammal populations showed no significant changes after glyphosate was applied to a 20-year old Douglas fir forest in British Columbia (Sullivan and Sullivan 1982). A comparison of 14 studies found variable impacts, with some species increasing and others decreasing, thought to be mainly because of habitat changes (Lautenschlager 1993). Impacts in large mammals are also generally thought to be negligible and due to changes in browse. For instance research into impacts of forestry herbicide treatment on snowshoe hares (*Lepus americanus*) found no detectable changes in population during summer and autumn and that vegetation had recovered 2-3 years after application (Sullivan 1994).

Similarly, glyphosate is generally found to be non-toxic to birds (Lautenschlager and Sullivan 2004), with any changes due to changes in composition of vegetation, although the authors point out that population impacts are often hard to measure on a landscape scale. Changes in bird species following glyphosate treatment after clearfelling in Nova Scotia found that although bird numbers were depressed for a couple of years after spraying due to reduction in vegetation, this affect was short-lived and less significant than the normal changes associated with succession (MacKinnon and Freedman 1993).

Research in North America found no significant decreases in amphibian populations after treatment (Code et al 1997). Direct effects on fish species seem to be low at recommended doses (e.g. Janz et al 1992 and Morgan et al 1991), but could be harmful at high doses (Morgan et al 1989). Observed impacts on aquatic invertebrates have also been generally been low (Lautenschlager and Sullivan 2004) The US EPA (undated) notes that glyphosate is strongly adsorbed to soil, with little potential for leaching to ground water. Conversely, research in the United States found that high levels of glyphosate reduced or eliminated some species of tadpoles in aquatic communities (Relyea 2004).

Invertebrates are generally less well studied (Guynn et al 2004), although direct toxicity seems to be low (Bohan et al 2005, Peterson and Hulting 2004) and e.g. no detectable impacts were seen on ground beetles after 7-9 years (Duchesne et al 1999). Studies of the impacts on spiders of glyphosate drift into field margins in the UK suggests that drift at rates greater than 360 g active ingredient per hectare could result in loss of spider biodiversity in agroecosystems, mainly as a result of changes in vegetation structure and microclimate (Haughton et al 1999).

Impacts on health: Glyphosate shows low levels of toxicity, which according to WHO (2004), does not represent a hazard to human health even if it enters drinking water. However, there have been some concerns about its long term health impacts and also the immediate health impacts of some commercial products *based on* glyphosate. For example, Marc et al (2004a) found that glyphosate causes a significant disruption of the cell cycle. They concluded that while their study did not show a direct cause and effect relationship between glyphosate and cancer, it did raise concerns about the potential increased risk of cancer from inhalation of glyphosate products.

A study on rats in 2004 (Benedetti et al 2004) indicated that glyphosate caused liver damage: "*suggesting irreversible damage in hepatocytes*". Another study on urchins (Marc 2004b) concluded that glyphosate, but more particularly the commercial herbicide Roundup that contains glyphosate, affected embryonic development and hatching. They found that "*Glyphosate, the active herbicide ingredient of Roundup, by itself delayed hatching (…). The surfactant polyoxyethylene amine (POEA), the major component of commercial Roundup, was found to be highly toxic to the embryos when tested alone and therefore could contribute to the inhibition of hatching*". On the other hand Williams et al (2000) concluded "*that the use of Roundup herbicide does not result in adverse effects on development, reproduction, or endocrine systems in humans and other mammals*."

In the UK, the most common reported incidents to the Health and Safety Executive's Pesticides Incidents Appraisal Panel (PIAP) are ones involving glyphosate

The US EPA (undated) notes that short term exposure to glyphosate can cause breathing difficulties while longer term exposure may cause kidney damage and have an impact on the reproductive system. Monsanto (2005), a major producer of glyphosate-based formulas of herbicides, disputes this however, based on a number of animal studies. The surfactant commonly used in glyphosate is *ethylated amines* which can cause irritation of the eyes, respiratory tract and skin and which have been found to contain *dioxane* (not dioxin) contaminants which are suspected of being carcinogenic. Accordingly, FAO has set standards of 1ppm for levels of the contaminant 1,4-dioxane which may be present in the surfactants (reference). In the UK, where safety standards are generally high, the most common reported incidents to the Health and Safety Executive's Pesticides Incidents Appraisal Panel involve glyphosate (HSE undated). The US authorities have recommended a no re-entry period of 12 hours where glyphosate is used in agricultural or industrial situations.

Implications for Uruguay: glyphosate seems to be one of the safest pesticides from the perspective of side effects on biodiversity. Care will need to be taken to avoid spray drift because this can damage non-target vegetation (for example in conservation areas) Health effects are apparently minor but data from the UK (where safety standards are quite high) suggests that short-term irritation is a real risk if workers are not properloy trained and equipped and all these issues need to be addressed in the IMS.

To come: analysis of the pesticide to be used on ants once these are identified in the IMS

Plantations and biodiversity

Key concern: plantation establishment might decrease biodiversity

The impacts depend on the habitat being replaced and on management strategies within the plantation: most importantly of all they depend on management of land within the plantation estate that is not planted with trees

Impacts need to be considered both at the **site** and, more importantly, at the level of the **landscape**.

At the levels of a site (i.e. the area that is planted) establishment of plantations invariably *changes* biodiversity and in many cases *reduces* the variety or at least the quality of this biodiversity as compared with natural habitat. Plantation trees are a crop and a good manager will be actively trying to eliminate many natural species (e.g. herbaceous plants, other tree species, fungi and many insect species) as a necessary part of maximising productivity. Several studies of modern plantations (for example Helle and Mönnönnen 1990, Hunter 1990, Baguette et al 1994 and Cannell 1999) have found that biodiversity decreased under plantations. There are exceptions, which will be described below. The impacts depend on the habitat being replaced and on management strategies within the plantation: most importantly of all they depend on management of land within the plantation estate that is *not* planted with trees. An increasing number of guides are available to help managers to address biodiversity issues within plantations (e.g. Knight, undated). Cossalter and Pye-Smith (2003) state that "*If a large swathe of natural forest is cleared to make way for a fast wood plantation, there will be a loss of biodiversity. Yet a similar plantation, established on degraded land, might bring about an increase in biodiversity*".

Oil palm production has impacted biodiversity in the Kinabatangan River, Sabah Malaysia

Nigel Dudley

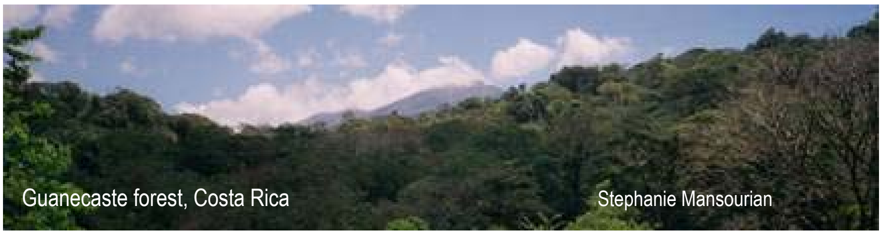
Whether these translate into an overall decline in biodiversity at a landscape level is more complex and still not fully understood.

The Center for International Forestry Research and International Union of Forest Research Organisation carried out a joint study on biodiversity in production forests although the focus was not only plantations (CIFOR and IUFRO 1999). In the UK, the Forestry Commission undertook research looking at plantations, biodiversity and best management (Humphrey at al 2003). The European Forest Institute coordinated a comparative study looking at planted and natural forests (Green 2001). Several studies have also been carried out in Australia (e.g. Knight undated), the United States (Brown et al 2006) and by WWF (Cabarle et al 2005). Together these provide a picture of likely effects, which are summarised in the paragraphs below; not all of these factors will affect plantations in Uruguay.

Possible impacts of plantations on biodiversity

A plantation is never a functioning natural ecosystem with a full range of species, ecosystem processes, disturbance patterns and age distribution. This is not a problem if management at a landscape scale maintains sufficient natural habitats elsewhere and here plantations may be a better for biodiversity than many alternative land uses, such as intensive agriculture. A range of potential impacts are listed below; these are not mutually exclusive, e.g. a plantation might reduce biodiversity at a site level but have a neutral or positive impact at landscape level.

- ✓ **A role in restoration**: plantations can also provide conditions to allow restoration in highly degraded sites. This has been used in the Guanecaste area of Costa Rica for example (Janzen 1987). In Ethiopia, where degraded soils no longer hold forest seeds, plantations provide soil cover and perches for birds that may return seeds. A study in the Munessa-Shashamane forest showed that 82 per cent of the woody species in a neighbouring relict forest could be found recolonising under the plantation (Lemenih 2006). Research in Australia found that plantations support higher densities of forest birds and mammals than cleared farmland, and slightly lower densities than native forest (Loyn et al 2007).


Guanecaste forest, Costa Rica Stephanie Mansourian

- **A role in landscape scale conservation strategies**: by providing linkages (corridors, buffer zones and stepping stones), plantations enable animal dispersers (particularly birds and bats) to travel further between natural forest patches, thereby also dispersing more forest seeds (Carnus et al 2003). Turnbull et al (1997) and Kanowski (2005) argue that well-designed plantations can be beneficial to biodiversity in a degraded landscape. The role of plantations in providing temporary habitat for migratory birds in Costa Rica has also been well studied (Parrish and Petit 1996). The position of the plantation in the landscape will be critical to achieve such a catalytic role (Montagnini, 2005). Conversely, badly-designed plantations have the potential to further fragment ecosystems and to isolate native flora and fauna (Gill and Williams 1996; Estades and Temple 1999).


Farners in Costa Rica are managing plantations to help provide habitat for a rare parrot species

Nigel Dudley

- **General increase in biodiversity on the site**: if plantations are established on highly degraded land, they can sometimes increase biodiversity. For example in China, Jiayu and Siming (1996) report that the establishment of eucalyptus plantations on barren land brought back birds and other species, with 71 bird species living in the eucalypt plantations of Guiqi County. In most cases only commoner species are found in these situations (Bernhard-Reversat 2001).

- **Increase in specific, valuable species**: some plantations can act as permanent or temporary habitat for particular valuable species (for instance endemic or endangered species). For example it is now known that the merlin (*Falco columbarius*) has adapted to roosting and breeding in spruce plantations in Wales, UK (Parr 1994) and plantations in New Zealand provide the only known habitat for a rare ground beetle species (Brockenhoff et al 2005). These specific cases are quite rare, and we might speculate that they are likely to be commonest in relatively slow-growing plantations.

- **Increase in particular groups or species**: some groups may be better able to adapt to plantations than others. Research in UK plantations (Humphrey at al 2003) found that while vascular plants, fungi and deadwood species all declined markedly in plantations, diversity of some invertebrate groups (e.g. beetles and hoverflies) was not dissimilar to native woodland.

- **Release of invasive species, including pests and diseases**: some plantation trees have themselves become invasive, but plantations have also led to introduction and spread of damaging pests and diseases. For example, in Kenya and Malawi, the indigenous *Juniperus procera* and *Widdringtonia nodifolia* are being damaged by a cypress aphid associated with introduced Mexican cyprus plantations (Ciesla 1991).

- ✓ **Reduced biodiversity on site**: when the plantation replaces valuable habitat, such as natural forests, rich natural or semi-natural grassland, heath, moor or tundra, overall lbiodiversity is likely to decline. For example studies in New Zealand have shown pine plantations to be poor habitat for native birds, particularly for those which feed on fruit and nectar, nest in holes or feed on insectivorous species (Clout 1984). Plantations are also likely to support more generalist than specialist species (Jactel et al 2005).

- ✓ **Reduced biodiversity both on and off-site**: if plantations replace rich natural or semi-natural habitat and are then inappropriately managed they will reduce biodiversity onsite and can also decrease biodiversity offsite. Impacts can include off-site pollution from fertilisers, pesticides and changes in stream sediment and sometimes damage as a result of increased human activity, such as illegal logging using plantation roads. For example, establishment of oil palm plantations in the Kinabatangan River in Sabah, Borneo, has drastically reduced native forest but also resulted in significant pollution of river, lakes and downstream mangroves (Vaz, undated).

As noted above, although there are exceptions in general biodiversity at a site level is likely to decline within a plantation compared to natural or semi-natural habitat although it may conversely increase compared with badly degraded land or intensive cultivation of agricultural crops.

Traps for mammals and reptiles in one of Stora Enso's plantation sites in Uruguay as part of an ongoing biodiversity study, with armadillo found on the plantation.

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Biodiversity at site level may well be less in fast wood plantations than in more traditional plantation forestry. A workshop organised by the International Union of Forest Research Organisations (IUFRO) in 2005 looked specifically at biodiversity in plantation forests and a final paper identified conditions likely to increase biodiversity (Jactel et al 2005). This is summarised in Table 5 below, along with an indication of whether these conditions are likely to be met in fast wood plantations.

Table 5: Plantations and biodiversity

Conditions in the plantation	**Fast wood**
Native species better than exotic species	X
Large genetic diversity better than narrow genetic diversity	X
Superficial is better than deep soil disturbance	✓?
Maintenance of coarse woody debris better than removal	✓
Leaving vegetation undisturbed better than use of herbicides	X
Long is better than short rotation	X
Retention of some trees is better than clearcutting	X
Open canopy is better than closed canopy cover	X

X = not the case in fast wood plantations; ✓ = the case in fast wood plantations

Results from the IUFRO meeting and elsewhere suggest that within plantations, biodiversity is likely to be highest in longer rotation, more natural plantations and lower in short rotation, intensively managed exotic plantations. Mixed species plantations are likely to support a greater diversity of native flora and fauna species than monocultures (Bibby et al 1989; Butterfield and Malvido 1992; Tattersfield *et al.* 2001). Some of the ways in which plantation managers have in the past been encouraged to improve conditions for biodiversity no longer exist in fast wood plantations. For example in Pacific Northwest of North America managers are encouraged to address issues of truncation of stand development, maintenance of dead wood and organic matter and management for within-stand vertical and horizontal heterogeneity (Hayes et al 2005). Such options are not suitable for intensively-managed fast wood plantations.

CSIRO in Australia has produced a biodiversity scorecard to assess the extent to which a plantation is meeting biodiversity aims (Freudenberger 2006): again many of these guidelines are not suitable for the most intensive plantations.

Table 6: **Biodiversity scorecard produced in Australia**

Theme	**Design principle**	**Management guideline**	**Max value**
Complexity (50 points)	Structure	1. Incorporate paddock trees	10
		2. Site preparation	10
		3. Preserving biological legacies	10
		4. Installing artificial hollows (nest boxes)	5
		5. Thinning and pruning	5
	Time and age	6. Rotation times	5
	Patchiness	7. Mosaics: mixed age stands	5
Composition (10 points)	Mix of species	8. Mixed plantings	5
	Local species	9. Planting with local species	5
Ecological management (15 points)	Weed control	10. Control escapees	5
		11. Control weeds	5
		12. Control animal pests	5
Total plantation biodiversity score at sites scale			**75**
Landscape scale (25 points	Connectivity	13. Measure of connectivity	15
	Width	14.Plantation width	10
Total plantation biodiversity score at landscape scale			**25**
Total plantation biodiversity score at site and landscape scales			**100**

This does not mean that biodiversity will not exist, but does suggest that the main biodiversity value of fast-wood plantations will be determined by management choices on land that has been set aside from planting within the plantation estate and on planning at a wider landscape level.

In cases where this non-planted land is managed actively for biodiversity, or restored, then net biodiversity within the site may even increase. For example the Klabin forest is one of several in in Brazil with a mosaic of land use, where eucalyptus and pine totalling 120,000 ha inter-mingles with natural forest of 85,000 ha (Brown, Palola and Lorenzo, 2006). This assumes that the plantation owner is prepared to set aside large areas of land partly or wholly for biodiversity conservation and ecosystem services. (However, in most situations a proportion of the estate will have to be set aside from planting for management reasons and this can often be used positively.) Conversely, if set aside land is mismanaged or is subject to pollution and other disturbance from the managed areas, then it may provide few benefits.

Implications for Uruguay: plantations will almost always have reduced biodiversity compared with native woodland, pasture or other habitats. They may conversely have higher biodiversity than intensively-managed cultural landscapes, including agricultural crops and some intensive pasture. Individual wild species may be able to adapt to and benefit from tree plantations. The extent to which plantations will increase or reduce net biodiversity depends to a great extent on the ecological value of the pasture being replaced: however in Uruguay grassland is an important natural habitat (see section on ecological history below) and therefore the assumption should be that there may well be a net loss *at site level*. However, this loss could be offset, and perhaps more than offset, at a landscape level if managementof unplanted land takes full account of biodiversity considerations, including both habitat management and connectivity

Can plantations save natural forests by replacing timber?

One area of sharp disagreement is about whether or not plantations can take pressure off native forests, by providing alternative wood supplies. Sedjo and Botkin (1997) have long argued that forest conservation will be best served by focusing production into a small proportion of the global forest estate and this is echoed by other analysts (e.g. Bowyer 2001). However, other studies have argued the reverse, for a number of reasons. If plantations are established in place of natural forests, they may themselves be a direct cause of deforestation. More generally, by reducing the value of timber from native forests, plantations also take away some of the incentives for such forests to be maintained (Sargent 1992). If natural forests are no longer considered valuable because plantations provide most of the valuable timber and fibre, then they may be degraded even more rapidly (FAO 2001). Timber extraction is not usually the only pressure on native forests and therefore, establishing timber or pulp plantations will not necessarily alleviate all the pressure or prevent the deforestation (Friedman in press). A key problem in many countries is that land ownership patterns are at a site level, and ultimately this is what will influence management decisions (Carnus 2003). The "displacement theory" of plantations will not work in isolation, but only if establishment and management of plantations are part of an integrated landscape approach to protection and management of forest resources. Many countries lack the mechanisms or governance capacity to ensure that plantation establishment is accompanied by forest conservation (Elliott 2003). Therefore plantations will not in themselves reduce pressure on native forests, but only if their development takes place against a backdrop of supportive policy and legislation, which is effectively applied.

Plantations and exotic species

Key concern: plantation trees or other introduced species, including pest species, might spread into surrounding areas

Invasive species are believed to be in global terms either the most important cause of biodiversity loss or perhaps second only to habitat conversion (McNeely 2001). International instruments for controlling invasive species are generally inadequate (CBD 2001) and some of the control methods used in the past have made things worse rather than better: for example some biological control agents introduced to control invasive species have themselves become invasive. Pressure on governments, companies and individuals to practice greater care in the management of invasive species is growing fast. Issues for plantations include:

- ✓ Plantation tree species becoming invasive
- ✓ Non-native species being introduced along with trees including pest species

Plantation species becoming invasive

Both *Eucalyptus* and *Pinus* species are invasive in some situations, including species planted in South American temperate grasslands. The US Forest Service lists *Eucalyptus globulus* – one of the commonest species planted in Uruguay – as invasive (US Forest Service undated); South Africa lists at least three *Eucalyptus* species amongst its serious invasives (ARC Plant Protection Research Institute undated). At least 19 *Pinus* species are considered invasive (Richardson 1998) including *Pinus pinaster*, *P. elliotti* and *P. taeda*, all commonly planted in Uruguay. *Pinus taeda* is a significant invasive species for Latin America (Richardson and Petit 2006) and is listed under The Nature Conservancy's Global Invasive Species Initiative (2005). *Pinus pinaster*, is listed amongst the world hundred worst invasive species by IUCN's Species Survival Commission (Lowe et al 2004). *Pinus* is also listed as an invasive genus in Uruguay on the Global Invasive Species Database (undated). On the other hand, invasive properties vary greatly within the genera. For example, *Eucalyptus dunnii*, one of the species under consideration in Uruguay, was given a rating of zero for invasive potential by the Pacific Island Ecosystems at Risk (PIER) assessment (PIER undated). [This paragraph can be expanded when final decisions on species are made]

Non-native species being introduced

Plantation development results in the spread of pest species, some of which can spread to native flora and fauna. Several pest species associated with *Eucalyptus* have spread far beyond Australia. The Eucalyptus psyllid (*Ctenarytaina spatulata*) is found widely in Europe, North America and South America, including Uruguay where it was first seen in 1994 (European and Mediterranean Plant Protection Organisation undated). An analysis of forest pests in Uruguay prepared by FAO lists six introduced insect pests of plantations (some only identified to genus level so may be more than one species) and four introduced diseases (Moore 2007).

Implications for Uruguay

Eucalyptus and pine are already found throughout the country, along with their associated pests and diseases, although the latter may increase. Any new developments will need to exercise strict controls to avoid spreading further exotic pests and diseases and may also have to invest time and money in controlling the spread of plantation species into native forests. Effective buffer zones and control removal from native woodland will both be needed.

Plantations and fire ecology

Key concern: plantations could increase fires both because they burn theselves or by drying out streams

Plantations can either result in increased fire – sometimes as a result of deliberate burning by disaffected communities, or conversely result in artificial fire suppression, leading to fewer but more serious fires. In some countries use of fire to clear land for plantations has itself been a serious environmental problem. For example in the serious fires that took place in Indonesia during 1997, the government believed that 80 per cent were started by plantation owners, industrial estates and transmigration operations and named 176 companies. In these cases fire is sometimes used to change classification of land to allow plantations: in the 1983 Borneo fire, land previously unavailable for commercial purposes was later reclassified from "protected" to "degraded" and so made available to timber and plantation companies. (Dudley 1997).

Plantations may also in some circumstances increase the risk of fire. Many plantation trees, including many *Eucalyptus* and *Pinus*, are regarded as pyrophytic, meaning that they catch fire easily. Even-aged monocultures lack the baffling effect that a natural forest mosaic has, which can slow forest fires, and uniform plantations create wind tunnels that can further spread fire. Exotic plantations have been associated with increased fire risk in parts of Spain and Portugal. In Australia, CSIRO (undated) identifies four main fire risk factors associated with *Eucalyptus globulus*:

- ✓ Rates of accumulation of hazardous fuel
- ✓ Fire behaviour and difficulty of suppression at different stages of plantation development
- ✓ Severity and frequency of fire weather
- ✓ Risk of ignition both within and outside the plantation estateb

Implications for Uruguay

Some of the most serious concerns about plantations and fires – mainly deliberate fire raising either to clear land for plantations or to protest against plantations – seem unlikely to occur. Plantations are on the other hand probably more likely to experience serious fires than pasture and fire management need to be a key part of the intergrated management system.

Plantations and long-term soil fertility

Key concern: plantations could deplete soil nutrients and productivity could decline after the first few rotations.

It has been known for many years that without replacement of soil nutrients, productivity of plantations can decline after a single rotation in some situations (Keeves 1966). However, most studies show that although site productivity can decline from one rotation to another, this is not an inevitable process and can be addressed by use of fertilizers, care during harvesting (particularly avoidance of soil compaction) and other conservation techniques (Binkley and Stape 2004). Research comparing fertilizer application at 127 different sites in Eucalyptus plantations found a strong correlation between fertilizer application and increased rate of growth, with increases greater for older trees. Responses varied between stands (Stape et al 2006).

A study undertaken by Julian Evans for the UK government (1999) concluded that "plantation forestry appears to be entirely sustainable under conditions of good husbandry, but not where damaging or wasteful practices are permitted".

At the present time, plantation productivity is still often increasing in successive rotations in given sites. For example, productivity has continued to increase in Brazil over the last three decades due to improved breeding, better clonal selection and silvicultural techniques including site preparation and fertilisation (Stape et al 2004).

In addition to use of fertilizers, other silvicultural techniques can help to reduce fertility loss, including retention of wood residues and companion planting with nitrogen fixing trees. For example research suggests that leaving woody residue on, or even better in the soil can substantially reduce nitrogen and phosphorus leaching following clear-felling – in this case of *Pinus radiata* (Carlyle et al 1998). A meta-study of 18 experiments planting *Eucalyptus* with nitrogen-fixing trees showed that productivity was usually greater and never less than in the case of *Eucalyptus* monocultures; successful mixtures often develop stratified canopies and contain litter (Forrester et al 2006).

Implications for Uruguay

Experience in the country suggests that plantation productivity can be sustained or even improved over more than one rotation, and this matches global experience. Plantation productivity relies on artificial fertilizers and they carry certain risks in terms of offsite impacts (examined above) meaning that care need to be taken in designing fertilizer strategies.

The impacts of intensification

As mentioned earlier, one of the challenges in the assessment is separating out experience on fast-wood plantations from those of the traditional plantation design, which in some cases are very different. The move to fast wood plantations has intensified some of the environmental impacts. There are both positive and negative aspects (often depending on local conditions and management choices). The table below attempts to summarise some of the costs and benefits, looking beyond the issues examined above.

Table 7: **Some of the impacts of intensification of plantations**

Area	Type of impact	Pros and cons
Energy		
Solar energy	**Positive**: greater amount of solar energy captured by the plantation	
Fossil fuel energy	**Depends**: more energy used because more frequent planting, harvesting, transport	Net impact depends on the balance between solar energy gain and fossil fuel loss – also latter non-renewable
Carbon		
Carbon storage	**Possibly positive**: more carbon stored in higher productivity	Needs to be balanced by increase use of fossil fuels
Water		
Water use	**Possibly negative**: more water used in total, risk of always harvesting during the period of maximum use so poor recovery	But modern cultivars are more efficient in terms of water use, impacts can be controlled by careful planning
Nutrients		
Nutrient use	**Hard to generalise**: greater use because of faster growth rates	Some new cultivars are more efficient in terms of nutrient use
		Depends to a large extent on whether residuals are left in the soil…
		…but conversely they can be used as an energy source
Fertilizer use	**Usually negative**: likely to be higher use, with potential side effects	Some new cultivars are more efficient in terms of nutrient use
Silviculture		
Pesticide and herbicide use	**Usually negative**: likely to be higher, with potential side effects	
Social impacts		
Employment	**Depends**: high productivity increases need for labour	But intensification has also brought mechanisation that can reduce labour needs
		Some jobs associated with intensive plantations are not high quality
Transport	**Negative**: more movement of timber	

These issues are examined in greater detail in Uruguayan conditions below.

Plantations and society

Social impacts work both ways – plantations can bring jobs and money into an area but can also result in social disruption and loss of rights. In the last few years, the social impacts of plantations have become a focus of discontent. The global "anti-plantation campaign" has been headed by the World Rainforest Movement, which is based in Montevideo, so that these issues will be brought to the fore in respect to any developments in Uruguay. At the same time, proponents of plantations claim that they can bring substantial and long-term benefits to communities and point to increasing evidence from research. In the same way as for environmental impacts, we summarise the key concerns that have emerged about plantations around the world and look at whether or not these are likely to have implications for plantations in Uruguay. Some of the issues that have been raised are summarised in Table 8 below. As above, at this stage the issues are merely noted; they are discussed and evaluated in the sections below.

Plantations are often an additional disruption to local communities that are already undergoing rapid social change – their role can be positive or negative depending on circumstances

Table 8: **Key areas of concern relating to the social impacts of plantations**

Issue	Notes
Land tenure and governance	***Key concerns***: **loss of land as a result of plantation establishment**, including at an extreme loss of all rights to traditionally held land or loss of rights of access, resource collection rights. Changes in land pricing disadvantaging local owners or would-be owners who can not complete against large foreign companies.
Forest resources and ecosystem services	***Key concerns***: **losses to ecosystem services** particularly when natural forests, which frequently supply multiple benefits to local communities, are replaced by single species plantations that have fewer values (e.g. may supply fewer non-wood forest products)
Political power	***Key concerns***: **loss of national or local power to outside companies**. Loss of power in a local setting as larger and more powerful players enter the field (this applies to both local communities and to national plantation companies.
Employment opportunities and wider economic implications	***Key concerns***: **loss of jobs or emergence of poor jobs**: replacement of secure jobs in agriculture or other forms of rural industry with fewer and / or less secure jobs in plantations. Concerns that jobs will go to out-sourced workers from beyond the region or perhaps to foreign workers rather than to local communities. There are also concerns about lack of knock-on effects to the local community
Employment rights and worker safety	***Key concerns***: **loss of workers rights and conditions**; lack of recognition of or antipathy towards trades unions, poor wages, lack of negotiating rights. Poor working conditions coupled with a high risk of accidents. Lack of safety training and low standards, particularly amongst out-sourced workers. Fears range from the direct impact of accidents on people to broader concerns that vab management will lead to socially-problematic environmental changes such as pollution or reduction in water flow.
Social conditions	***Key concerns***: **rural depopulation**: plantations will result in an increased rate of rural depopulation and an aging rural population. Fears that an influx of migrant workers will result in social disruption, increased crime, prostitution and drug abuse.Lack of transparency from plantation companies.
Transport	***Key concerns***: **noise, pollution and damage to road systems** from a greatly increased traffic from heavy goods vehicles. Erosion as a result of poor road maintenance

Most environmental impacts will also have important social knock-on effects: e.g. possible impacts on water availability, pollution and soil erosion all feature high amongst stakeholders' concerns, but these have been addressed in the section on environment previously.

The table above has been designed to give structure to the following section, which aims to examine the potential bad news and see what might be valid in Uruguay, but it perhaps gives a false impression of the tenor of debate. In practice many communities have a mixture of positive and negative reactions towards plantations and Table 9 below attempts to summarise some of the positive and negative perceptions (based on Schirmer 2006 with additions).

Table 9: **Positive and negative perceptions of the social impacts of plantations**

Positive perceptions	**Negative perceptions**
Plantation establishment can lead to revitalisation of rural communities	Plantation establishment can lead to decline in local population and loss of local culture
Plantation establishment can bring in the resources and stimulus to improve local / regional services and provision	Plantation establishment lads to loss of local services (e.g. schools, shops, clubs)
Plantation establishment provides employment opportunities	Plantation establishment provides less employment per hectare than alternative land uses
	Plantations provide less secure jobs than other land uses
Plantation establishment leads to land price increases and thus helps bring wealth into the community	Plantation establishment leads to land price increases and thus puts poorer local people at a disadvantage
	Plantation establishment leads to land price decreases
Afforestation has positive impacts for other land use and rural industries	Afforestation has negative impacts for other land use and rural industries

Plantations will not come without changes. There are no more “resource frontiers”, i.e. places with exploitable natural resources and no human populations. Virtually every change of land use, new development, or expansion of any resource use now involves some degree of conflict and trade-off (Ayling and Kelly 1997). Plantations are often one factor amongst many affecting rural communities, which are undergoing a period of rapid social and economic change in virtually every country in the world. A study for the International Tropical Timber Organisation pointed out that: “*The social and economic conditions that exist when a forest crop is harvested are seldom the same as those prevailing when a tree seedling first takes root, nor do the priorities of individuals remain the same*” (ITTO 2002).

There is also generally less known about the social impacts of plantations – particularly fast-wood plantations. Studies so far have helped to answer some but not all of the questions referred to in Table 9 above. Analysis by Schirmer (2006) found that there were still only a limited number of studies, generally looking at quite a narrow range of issues and focusing mainly on perceptions about impacts and issues of employment and spending. Very few studies have looked at independent evidence about whether plantations lead to change in rural populations, businesses and services; land prices or changes over time (Schirmer 2006). With that caveat the following analysis (pages 57-65) which is necessarily less detailed than that on environmental impacts, summaries information about the range of concerns identified, attempts a judgement about their seriousness and looks at whether or not they are likely to be important in Uruguay.

Land tenure and governance

Key concerns: loss of land and tenure rights as a result of plantation establishment

Land tenure issues are often the most significant question facing plantation companies (Evans and Turnbull 2004). Plantations require large areas of land: either obtained through purchase or long term lease. Because land has both an economic and an "emotional" (sometimes also spiritual) value to local communities, its takeover or use by plantations can cause significant resentment, sometimes particularly if the company is foreign-owned. These issues are not confined to developing countries but have been subject of debate for instance in New Zealand at the time of privatisation of state forests (Roche and Heron 1993).

At an extreme, people have been forcibly displaced from their land to make way for plantations. In particular cases, (e.g. in Indonesia) the government may take land from communities in order to lease it to plantation companies, arguing that this is in the greater national interest (Cossalter and Pye-Smith 2003). No study of the extent to which this has happened on a global scale is available, although probably in small minority of cases. Semi-legal processes are used, for instance where land rights granted to local communities were not confirmed with official deeds. Without documentation, communities are at risk of eviction from traditional homelands. In Brazil for instance, a number of indigenous peoples were displaced to make way for a plantation managed by Aracruz, leading to a conflict that has lasted over 30 years (De Nadai et al 2005).

Compulsory purchase of land to create state forests in Wales, UK, has led to long-term resentment from communities. The situation in many countries is far worse than this, with little if any compensation for loss of land or livelihood.

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Communities and individuals may be displaced through economic means. Large plantation companies can afford to pay more for land and quickly drive up the price when it is known they are interested in investing in a region (Carrere 2006). This phenomenon is not confined to developing countries but has also been seen for instance in Australia (Kelly and Lymon 2003). Plantation forestry in Australian had a major effect on land prices for land suitable for *Eucalyptus* (Schirmer et al 2005).

Plantations tend to have to be large to be economically viable. In many instances this will impact on land ownership, creating an increasingly unequal distribution of land with large areas of land concentrated in the hands of a few plantation companies/owners. This can contribute to rural decline. Charnley (2006) describes the example of Kamataka state in India where the government leased out former common land (from which locals derived a range of benefits such as medicines, fuelwood and fodder) to large plantation companies. The result was that locals could no longer access benefits, forcing many to migrate to urban areas.

Implications for Uruguay

All land used for plantations in Uruguay is either privately-owned and leased or bought directly. There is a strong rule of law and no opportunity to turn people out of traditional or common land; there are also no indigenous people left in Uruguay. Some of the most emotive issues relating to land tenure will not occur here. Nor is there a landless peoples' movement, as is the case in Rio Grande dio Sol as yet, and indeed no apparent shortage of land. Rural depopulation is a larger problem than lack of land. The presence of plantation companies in the landscape will almost certainly push up the price of land, which will benefit existing land-owners but will put local would-be purchasers at a disadvantage.

Forest resources and ecosystem services

Key concerns: loss of ecosystem services and other benefits from pasture planted with trees

While natural forests provide a range of benefits to communities living in and around them, the number of goods and services generally provided by plantations is much more limited. ITTO (2002) suggest that "*multi-purpose trees may have an especially important role for local communities*".

When plantations are established in areas of natural forests or grasslands, they may increase the pressure local people place on remaining natural forests. Potential reduction in water also has important social consequences. In South Africa reduced water flow due to plantations is reportedly forcing women to walk further to collect water (Mayers and Vermeulen, 2002).

Amongst the broader resources and ecosystem services supplied by forests are outlined in Table 10 below (adapted from Dudley et al forthcoming)

Many local communities rely on products from grassland habitats

South Africa: Nigel Dudley

Table 10: **Potential resources and ecosystem services from natural systems**

Types of benefits
Food and drink
Wild game
Wild food plants
Fisheries and spawning areas
Traditional agriculture
Livestock grazing and fodder
Non-commercial water use
Commercial water use
Cultural and spiritual values
Cultural & historical values
Sacred natural sites/landscapes
Pilgrimage routes
Health and recreation
Medicinal herbs for local use
Pharmaceuticals
Recreation and tourism
Knowledge
Research, traditional knowledge
Education
Genetic material
Environmental benefits
Climate change mitigation
Soil stabilisation
Coastal protection
Flood prevention
Water quality / quantity control
aterials
Non-wood products
Management / removal of timber
Homeland, security of land tenure
Home for local communities and indigenous peoples

Implications for Uruguay

Given the prior nature of land use, relatively few of the services listed in Table 10 are likely to be significant. Natural forests will not be replaced by plantations. Most land bought for plantations is already privately owned and is unlikely to be used for subsistence by outsiders, or even for recreation. The main issues likely to be important here are:

- ✓ Ecosystem services including particularly water
- ✓ Fears about pollution of water courses, particularly when used for fishing
- ✓ Specific agricultural uses, mainly grazing and apiculture

Key environmental services from pasture include water, grazing and apiculture

There is already a strong perception in Uruguay that plantations have reduced water availability, for example according to testimonials from local communities collected by the World Rainforest Movement. For example one community leader is quoted as complaining that "*because of the eucalyptus trees the Arroyo Negro stream dried up, it used to be the town beach…*" (Carrere 2006). At the moment there is little hard data to confirm or refute these claims, meaning that personal observations from local people provides the best evidence we have. Objections to the FSC certification process in Uruguay have been in part because certification was claimed not to have taken sufficient account of impacts on the water regime and on local flora (Snoeck et al 2007). There are also concerns raised that plantations will reduce space for bee-keepers and that Eucalyptus provides poor resources for bees.

The question of water resources has been discussed above and will be examined in the recommendations section below. Other issues of fishing, grazing and apiculture will require management decisions on individual sites.

Political power

Key concerns: loss of local and national political power to large foreign-based companies

Plantation companies tend to be large corporations, which are perceived with suspicion by local people in many parts of the world (e.g. see analysis in Hellström 1996), but also as potential sources of income and stability. There is also often a perception that there is collusion among powerful decision-makers, i.e. donor and recipient governments, plantation companies and even in some cases big inter-governmental agencies like the World Bank or Asian Development Bank, leaving local communities isolated and without a representative voice (Carrere and Lohman 1995). Kanowski (2005) points out that the cultural differences between the private sector profit-oriented mentality of plantation companies and rural communities can also cause problems. Many stakeholders have unrealistic ideas about large companies, either optimistically believing that they can come into an area and solve many of the existing problems or that they will be like some enormous monster eating away at the environment and local rights.

Many stakeholders have unrealistic ideas about large companies, either optimistically believing that they can come into an area and solve many of the existing problems or that they will be like some enormous monster eating away at the environment and local rights

Political control is often tied up with the economic incentives. In some cases considerable economic advantages have been given to plantation companies thus, distorting the market and negatively affecting smaller players (Bull et al 2005). Governments are anxious to encourage investment in plantations to stimulate the rural economy, but this often means that they are supporting some of the richest companies in the forest sector, thus attracting criticism on social and political grounds. Incentives may be subsidies, tax breaks or grants.

These issues are larger than single projects and virtually every other country in the world is having some debate about the role of large corporation and a large literature about the pros and cons or globalisation (for some opposition views see Hines 2000 and Stiglitz 2002).

Implications for Uruguay

The government of Uruguay has given strong political support to building the plantation sector and to attracting foreign companies. This is an issue of debate, with the Red Uruguaya de ONGs Ambientalistas de Uruguay claiming that government tax breaks to large plantation companies (exemption from land taxes for plantation areas, no tax on capital gains from tree plantations and duty free importation of equipment and supplies utilized in plantations) will give them a huge comparative advantage over smaller players and also reduce net income to the country by what they estimate to be US$97-120 million (2006). Other analysts are more positive, seeing the net benefits to the country outweighing the costs (e.g. Snoeck 2007).

Stora Enso is a large foreign-based company and will never be a popular player with those who oppose either large companies on principle, or those that are foreign based. It can however address some of the common concerns about foreign-based companies by maintaining highest standards, providing a measure of local or regional control and ensuring that significant profits remain within the country.

Employment opportunities and wider economic implications

Key concerns: that jobs in agriculture will be lost and not adequately compensated by jobs in plantation forestry; outsiders getting the best jobs

Employment on plantations varies from trained jobs such as harvester operators to less skilled labour.

A common argument for plantation establishment is that plantations provide employment. New jobs can certainly be created. In Vietnam for instance, the FAO calculated that by 1991 the forestry sector had provided half a million households with jobs (FAO 1996). According to Cossalter and Pye-Smith (2003), in Congo, the establishment of the Unite d'Afforestation Industrielle du Congo's eucalyptus plantations employed 9 people per 100 hectares (5000 people for 45,000 ha). According to the director of the Brazilian Pulp and Paper Association in a presentation to FAO in 2005, plantations created 1.5 million jobs in Brazil (Leonel 2005).

However, net benefits are influenced to some extent by the land being displaced and the nature of employment. Some jobs may be seasonal. On eucalyptus plantations much of the labour tends to be needed only during plantation establishment and again during harvesting; unless there is a large enough area of plantations to maintain a continuous cycle then many jobs will be temporary. On pine plantations more work is necessary as the trees grow, as they generally require more active thinning and tending (Charnley 2006). The question of who gets the jobs is also critical in determining both local economic impacts and local attitudes to plantations, particularly whether they go to people from local communities or contractors from outside.

The most detailed studies of the long-term employment implications from plantations have been in Australia, where rapid plantation development has taken place in the last few decades, mainly on former agricultural land and pasture. Studies have focused both on employment itself and on attitudes to plantations amongst rural communities (e.g. Schirmer et al 2000). A meta-study of 57 regional studies in Australia (Hayter 2003) found that plantations and wood processing were identified as an important contributor to the local economy, although in the former case the arrival of new types of industries were bringing a level of uncertainty for local businesses. Information gaps were identified in terms of social assessments and economic appraisals of forestry-related activities, comparative socio-economic assessment processes over time and analysis of non-market values of forests (e.g. recreation, water quality and aesthetics) associated with native forests and plantations.

In some areas of Australia, plantation expansion is believed to have created important social advantages in terms of secure employment (Mercer and Underwood 2002). Detailed studies found that pine generated more employment than *Eucalyptus*. Neither generated as much as dairying but post-harvesting *Eucalyptus* and pine generated more employment that sheep and cattle: wheat produced less employment than any of the alternatives. Pre-harvest *Eucalyptus* created fewer jobs than any of the alternatives except for wheat, meaning that there was a lag time between establishing the plantation on most of the jobs coming on line. Most jobs were in contracting business (Schirmer et al 2005). Far more important overall in terms of creating jobs is processing the reslting timber. For mature softwood plantations approximately two thirds of the employment is in processing and a third in growing, harvest and haulage to the mill (Schirmer et al 2005). With respect to associated jobs, research in Australia found evidence of a further 0.65-1.3 jobs were created in the area for each job directly related to plantation forestry (Bureau of Rural Sciences 2005a). So for example in the Southwest Slopes region of New South Wales, between 2003-2004 there were 1680 full time jobs in the industry, equivalent to 1.53 full time job equivalents per 100 hectares of which 0.5 were in the plantation and 1.03 in processing industries. Unemployment in the region fell during this period (Bureau of Rural Sciences 2005b).

Australian studies have tended to take place in conditions where agriculture is already in decline, which has complicated analysis. Efforts have been made to factor in how plantations affected other rural industries. Research in the Great Southern of Western Australia region found that while farmers were certainly selling land for plantations, the shift has not been associated with higher than average population or service decline and that in some areas of the Great Southern where plantations are expanding are also experiencing rural growth (Bureau of Rural Sciences 2005a).

Studies in South support the idea that permanent jobs can be created. Here, the industry reports that plantation forests and wood processing industry employ 152,000 full time staff of which 46,000 work in forests, with half being unskilled or semi-skilled. The forest industry claims that each job created in the sector reslts in four others in supporting industries, which assuming a dependency factor of five means about 3 million rural people depend on forestry for their livelihoods (Smit and Pitcher 2003).

Implications for Uruguay

There have been claims that in Uruguay plantations generate fewer jobs than cattle-raising (Galli 2004) although a study by Geary (2001) suggests that plantations create more jobs than the farms they replace. Experience from elsewhere suggests that once plantations are growing, there is likely to be equivalent or slightly more work than in cattle raising, although this depends in part on the degree of mechanisation of the industry (which also has health and safety implications).

Jobs will be different and there is likely to be concern about the implications for the traditional gaucho culture if large areas of pasture are converted to plantations.

Several stakeholders in Uruguay state that one advantage of plantations over traditional rural land uses is that they have a longer chain of economic activity (CBI 2005). However, this depends on how the timber is sventually used. If the Australian and South African experiences are typical, the extent to which the plantation project contributes to employment will depend largely on when and if a pulp mill or other processing plant is established because the majority of jobs are linked to downstream processing. Export of raw wood from Uruguay would be likely to cut potential jobs for the country by two thirds.

There is also an important question of whether most jobs go to local communities or to workers from far away; this may not affect overall employment levels but has major impacts on how such employment is perceived within the plantation landscape.

Employment rights and worker safety

Key concerns: lack of workers rights and poor safety standards

FAO notes: "… contractors may not be covered by labour legislation and these workers may enjoy much less protection than workers in a formal working relationship… contractors may be forced to overextend themselves and their employees through a high pace of work and excessive working hours .."

Labour conditions on plantations have not always had a good reputation. Some plantation companies have bad safety records, exacerbated by poor training and a lack of safety equipment. This is perhaps particularly the case when migrant workers are used (IFBWW 2004). Contract labour and outsourcing is a particular concern and over the last decade there has been a general increase in such contractual arrangements. With multiple contractors, wages tend to drop, employment conditions worsen, and it becomes difficult for companies to drive improvements in health and safety. FAO notes: "… contractors may not be covered by labour legislation and these workers may enjoy much less protection than workers in a formal working relationship. Under pressure to cut costs in a very competitive market, contractors may be forced to overextend themselves and their employees through a high pace of work and excessive working hours or to resort to illegal practices" (FAO 2006). Contractors will require investment in training and careful supervision is environmental and social safeguards are to be maintained.

The International Federation of Building and Wood Workers has identified a number of key elements of working conditions that would contribute to sustainability (shortened from Bowling 2000):

- ✓ Right to organise
- ✓ Remuneration and living conditions – fair compensation and adequate living and working conditions
- ✓ Health and safety – eliminate preventable accidents and diseases and ensure safe working conditions
- ✓ Equality – equality and opportunity regardless of race, colour, age, political opinion, sex, age, political opinion, national extraction or social origin
- ✓ Child labour – eliminated
- ✓ Forced labour – abolished
- ✓ Participation – full workers' participation in decision-making that directly affects their conditions of working and employment
- ✓ Training – ensuring required competence in areas of work
- ✓ Job security – long-term job security
- ✓ Contract workers – equality with regular workers in terms of rights
- ✓ Migrant workers – locally trained workers, living locally, used when possible
- ✓ Indigenous people – rights should be respected
- ✓ Community involvement – respect for social fabric of communities, consult on issues affecting well-being

Implications for Uruguay

This is one area where clear company commitment to best practice can address any concerns raised about recognition of workers' organisations and quality of working environment. There may be some trade-off between the quantity of employment and the safety: there are more jobs for chainsaw operators than harvester operators in a given forest area, but the latter is far safer.

Social conditions

Key concerns: social disruption as a result of plantation establishment.

Plantations can help to revitalise communities by bringing fresh jobs and sometimes also new people into an area. Conversely, critics of plantations argue that their establishment can have negative impacts on the social structure of the area; for example as a result of an influx of migrant workers which may, if not well managed, cause social tensions including increased crime, prostitution and drunkenness or other forms of drug abuse. Gender imbalance can occur as numerous young men are brought to an area to supply strong labour.

Many of these problems are not restricted to plantations, but will affect any large development project; indeed issues of pollution and to some extent land tenure are likely to be more extreme in the case of large food plantations.

Implications for Uruguay

An exercise by the US-based Consensus Building Institute, looking at questions relating to pulp mills in Uruguay, found concern about social change and prostitution arising from migrant workers to be high on the list of concerns of communities in plantation areas (CBI 2005). There are also longer term concerns about what happens when the plantation finishes and the company eventually leaves again.

The scale of possible impacts will depend to some extent on the extent to which plantations are concentrated in a small area – widely scattered plantations will be unlikely to attract such large numbers of people that serious social disruption will take place. Impacts will also depend to some extent on the proportion of incomers as opposed to local workers. The potential for both positive and negative social changes will be far greater if a pulp mill is built.

Transport

Key concerns: noise, dirt and possibility of accidents from transport.

Most local people will interact most directly with plantations when logs are transported to a mill or port. Although some local people have expectations that plantation projects may be a way of improving roads, and even building additional roads that they can use, other fear increasing noise, dirt and the possibility of accidents. A plantation project of the size planned by Stora Enso will have many truckloads of timber moving every day. This has already been identified as a potential problem in other plantation projects in the country (CBI 2005).

This section will be expanded when we know more about transport plans in the Stora Enso project

Summary of key implications for Uruguay

The previous section has outlined in some detail the current global criticism about plantations and a range of environmental and social issues. Table 11 summarises these (and a few other issues) and makes an estimate of the extent to which each one might impact on decisions relating to the project under review.

Table 11: **Preliminary notes on some likely influences on plantations in Uruguay**

Issue	Likelihood that this will be a significant issue in Uruguay
Global context	
Climate change	Likely to have impacts on growth rate etc although possibly not in the timescale of the project
Regional political opposition	Possible knock-on effects from existing debates – e.g. about the pulp mill in Fray Bentos
International NGO opposition	Possible growth of opposition to large plantation projects
National opposition	Possible growth of opposition to large plantation projects, but also currently strong support for pulp at a national level
Market for plantation products	Currently quite high, likely rapid continued increase in demand particulary with respect to biofuels
Energy / fuel availability	Possible impacts on profitability if there were a significant increase in fuel costs for transport of products overseas
Environmental context	
Water quantity	A key concern of local communities, possibility of localised impacts, will need careful monitoring
Water quality	Unlikely to be a major impact if the company applies a strong Integrated Management System
Soil health issues	
Agrochemicals	
Biodiversity at landscape scale	Good management and monitoring provides the possibility of having a neutral or even a positive impact; poor planning and management could have a harmful effect
Exotic species	Will need careful monitoring and management to keep plantation species out of natural forests on company land and surroundings
Fire	Careful management needed
Long-term soil fertility	Fertilisation will be needed; care needed to avoid excess
Social context	
Visual impact	Some concerns but unlikely to be a key issue
Land tenure	Not an important issue at the moment with the exception of some general opposition to foreign companies owning land
Resources and ecosystem services	Main concerns are water services, access to grazing and perhaps apiculture
Political power	Continuing opposition to be expected from people who oppose foreign companies
Employment and economic development	Major changes that could have positive or negative impacts depending on the particular social groups and on companiy policies
Employee conditions and worker safety	Both require strong and positive commitment from the company to avoid problems
Social conditions	Possibility of revitalising a depressed area but will require careful management
Transport	Likely to be a point of contention but mitigation possible

Section 2

Conditions in the plantation landscape

Physical environment

Biological environment

Social environment

Introduction

A key task of the analysis was to determine the physical, social, biological and cultural conditions in the area that Stora Enso wishes to plant. This was no easy task: the area is one of the least studied in the country and much of the information that we would have liked to obtain remains unknown. Accordingly, Stora Enso commissioned a group of local experts from a wide range of disciplines (see Appendix 1) to provide landscape characterisations for the area, identify gaps in knowledge and suggest a number of indicators for both planning and monitoring. Section 2 describes their main findings, starting with a summary of key points distilled from a wrap-up workshop in March 2007.

Data: were collected by experts, who also came together in a cross-disciplinary workshop to discuss results, identify indicators and suggest next steps for the company.

Indicators given in the following sections were those suggested by experts in individual fields at our request to provide a first basis for discussion – these were later refined in a cross-disciplinary workshop and will be further examined in a workshop involving local stakeholders directly affected by the plantation project. **The fact that the indicator is suggested in section 2 of the report does not necessarily mean that it will be adopted by the company** – more indicators have been suggested than are practical for a single operation to monitor. They are included here to indicate the process by which the monitoring system is being established.

Participants in the workshop on landscape characterisation and identification of indicators, March 2007, Montevideo

Project location area

The area where Stora Enso is seeking to buy land – the "plantation landscape" – covers 31,500km^2 or 18 per cent of the surface area of Uruguay

Stora Enso has defined the area of land in which it is seeking to buy farms and other properties to establish plantations – the so-called *plantation landscape*. As presently delineated, the area of interest is located in the centre of Uruguay, mainly southern Tacuarembó and practically all the department of Durazno along with parts of eastern Paysandú and Río Negro and small areas of northern Flores and northern Florida. This area represents 18 per cent of the total surface of Uruguay (31,500 km^2 approximately) and includes some or all of four basins: Queguay, Tacuarembó, Merin Lagoon and most of the basin of Río Negro (Achkar et al 2004): Figure 5 below shows the polygons currently being explored for possible plantation establishment.

The plantation landscape is still only approximately fixed and has changed during the development of the analysis; it is possible that it will change again in the future, in which case the analysis in this report will no longer be complete.

Note: we need a map without the dollar figures

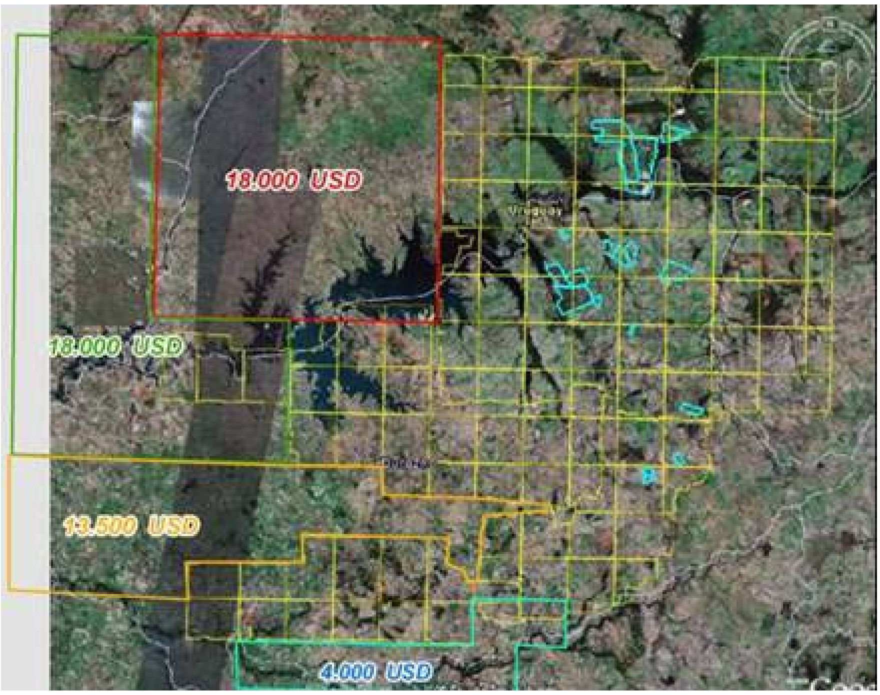
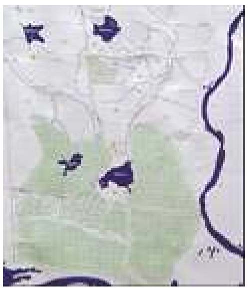


Figure 5: **Current extent of the plantation landscape**



When individual sites have been bought, they are also mapped by the company

Not all the plantation landscape is suitable for trees: further refinement will result from analysis of soils, hydrology, proximity to settlements and availability of land. Refining the area of interest for Stora Enso is one of the aims of the current project. Constraints exist at a landscape scale and more local constraints even within individual properties. Several properties have already been purchased and most of these have been visited during the assessment.

The area includes seven of the eleven landscape units defined for the Uruguayan territory: basaltic hill ranges, crystalline-metamorphic hill ranges, sedimentary and basaltic hillocks, sedimentary, crystalline and basaltic hills and hillocks, as well as lakes and lagoons.

The Physical Environment

The success or failure of the plantation will depend largely on making sure that the environmental conditions are optimal; this will also affect to a large extent the degree to which the plantation has wider impacts on water quality and quantity and on the general conditions of the area. Critical issues relate to the geology and particularly hydrogeology and the soils. The research team therefore contracted a number of specialists to look into these issues in detail and report back on the strengths and weaknesses of the landscape under consideration and on any particular steps that the company needs to take to maximise chances of success. Their work in summarised in the section below.

Geology

Geology of the plantation landscape

The Northern Uruguayan Basin is found in the northwestern, northern, northeastern and central region of the study area. It is part of the Chaco-Paraná Basin, which covers 1,500,000 km^2 in Argentina, Brazil, Uruguay, and Paraguay. Rocks from the Precambrian Era are found in the southwestern, southern and southeastern region of the study area, in the territories Piedra Alta and Nico Pérez, separated by the shear zone Sarandí del Yi-Piriápolis. Figure 6 shows a geological map of the area (modified from Bossi et al 1998).

The temporal and geographical locations of the geological formations that make up the subsoil of the study area are briefly described in the box overleaf.

Issues relating to site selection for plantations

Two issues related to the area's geography appear to be of particular importance:

- ✓ Identification of areas of mining interes,t for example either for the exploitation of kaolin in the Formation Cordobés or collection of ornamental rocks and gravel from rock fragments in the crystalline basement. Potential mining areas may overlap with areas of interest for forestry: the government has right of compulsory purchase for mining so it may be worth avoiding planting in these areas.

- ✓ Identification of areas with calcareous sediments from Cretaceous materials, which generate soils with high contents of calcium carbonate (*blanqueales - whitish lands*) that may hinder or prevent the normal growth of the trees and again are to be avoided.

To check:

1. Why are high calcium soils bad for trees?
2. How many areas might there be a possible clash with mining?

Box: stratigraphy of the study area

Precambrian (south): made up of low-grade metamorphic belts, corresponding to hard, tough rocks found in rocky outcrops or covered by poorly developed soils.

Devonian Formations (southern-central and southeastern area): sediments up to 300 m thick and separated into three formations that reach the surface, described from bottom up:

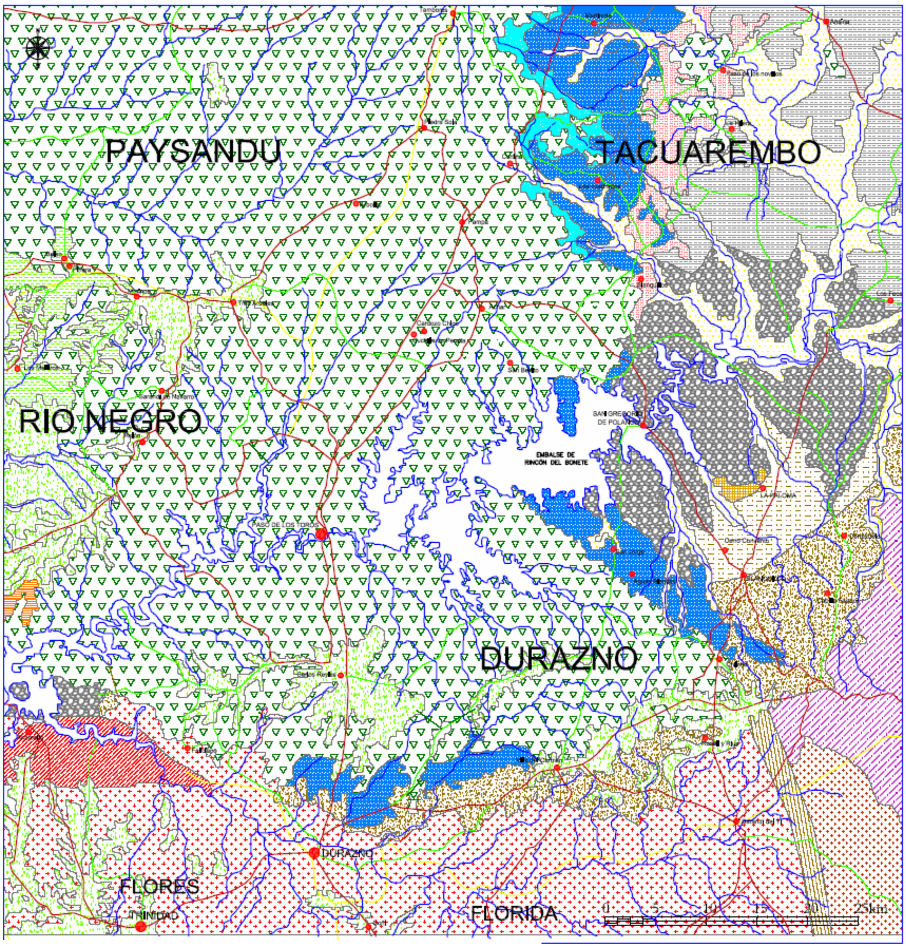
- ✓ **Cerrezuelo Formation**: mainly coarse to fine grained arkoses and kaolinitic pelites
- ✓ **Cordobés Formation**: predominantly light grey to dark gray pelites
- ✓ **La Paloma Formation**: including pelites – more frequent at the base – and fine conglomerates at the top of the formation

Carboniferous-Permian Sequence (Carboniferous-Permian) (eastern and southeastern area): After a new erosive period in the Late Carboniferous, sedimentation began in the Northern Uruguayan Basin, represented by the San Gregorio, Tres Islas, Melo and Yaguarí Formations, mainly from the Permian and Late Permian Periods and the Buena Vista, Tacuarembó and Rivera Formations from the Triassic and Jurassic Periods:

- ✓ **San Gregorio Formation**: from a glacial environment, made up of resedimented diamictites, tillites, and in lower proportions, by clast-supported conglomerates
- ✓ **Tres Islas Formation**: making a transition to a deltaic and fluvial environment, represented by fine to very coarse psammites, sometimes slightly sabulitic, with significant although variable percentages of pelites and lower amounts of psefites
- ✓ **Melo Formation**: representing a new marine transgression, predominantly sandstones and heterolitic, with small amounts of politic and psefitic facies
- ✓ **Yaguarí Formation**: massive or layered psammites and pelites – a lower deposit made up of fine materials and an upper one of sand grains
- ✓ **Tacuarembó and Rivera Formations (Jurassic-Cretaceous)** (south and north-south band in the central area): the first contains fine and very fine sandstones and pelites of light colours; the second eolic sandstone in dune structures.
- ✓ **Arapey Formation (Upper Cretaceous)** (west, northwest, north, south and centre of the area): the sedimentary sequences are partially covered by deep basaltic defiles corresponding to the Mesozoic Magmatism, occupying most part of the study area.
- ✓ **Guichón and Mercedes Asencio Formations (Cretaceous)** (western area): thick layers deposited during the Cretaceous in the Northern Basin. The Guichón Formation reaches the surface in outcrops in a very limited pat of the central eastern area, made up of conglomerated to pelitic sandstones. The Mercedes Asencio Formation consists of granules that vary from fine sandstone to conglomerates, with cement usually clayey and calcareous with limestone lenses. Ferricrete (iron-cemented conglomerate) is present in a significant part of the area.

The Cenozoic cover is represented by the Fray Bentos Formation and by recent and current deposits.

- ✓ **Fray Bentos Formation (Miocene)** (western area): silty rocks with variations in the content of clay, fine sand and calcareous material



Key

Recent and actual
Fray Bentos (Miocene)
Mercedes-Ascensio (Cretaceous)
Guichon (Cretaceous)
Arapey (Cretaceous)
Rivera (Jurassic superior, Cretaceous inferior)
Tacuarembo (Jurassic superior)
Yaguari (Permian superior)
Melo (Permian)
San Gregorio (Permian inferior, Carboniferous superior)
La Paloma (Devonian)
Cordobes (Devonian)
Cerrezuelo (Devonian)
Terrencio Piedra Alta (Pre-Cambrian)
Centuron Arroyo Grande (Pre-Cambrian)
Cizalla Sarandidel (Pre-Cambrian)
Batolito de Illescas (Pre-Cambrian)
Valentines (Pre-Cambrian)

Figure 6: **Geology of the plantation landscape**

Hydrology

The study area includes part of the Paranaense and Meridional Hydrogeological Provinces. Both porous and fissured aquifers are found in the area. Each province is divided into sub-provinces, according to the hydrogeological behaviour of the subsoil materials. The map in Figure 7 shows the productivities of the different aquifers, classified according to the specific flow (q) of the perforations, reflecting their importance in relation to their potential.

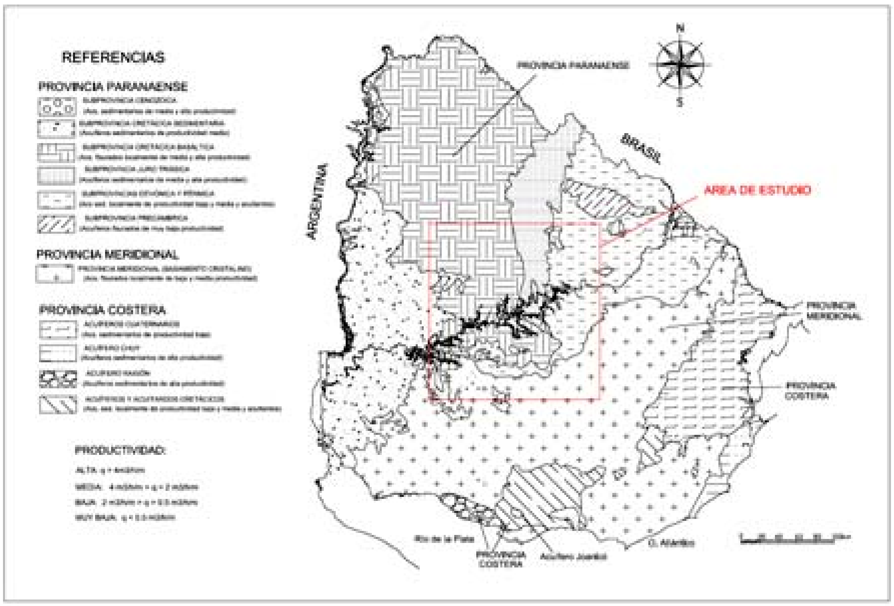


Figure 7: **Hydrology of the plantation landscape**

Issues relevant to plantation development

Eucalyptus or pine plantations can reduce the net surface water flow and recharge of aquifers in the plantation area.

Surface water: the exrtent to which plantations can affect surface water flow depends to a large extent on how close they are planted to rivers streams and standing waters. Accurate mapping of such areas and agreeing suitable buffer zones are both important parts of planning. Buffer zones (areas not planted with trees) should vary according to the presence of aquifers (see below) and volume and consistency of the water flow.

Aquifers: impacts are noticeable in free aquifers with saturation levels near the surface, and less evident in semiconfined aquifers; there is no noticeable effect in confined aquifers. In free aquifers, recharge areas are the most affected. Therefore, recharge areas need to be identified in order to avoid a negative impact on the water resource. In this case the most vulnerable aquifers are Cerrezuelo, Guaraní Aquifer System, and areas of fissured aquifers.

Potential indicators for planning plantations and conserving groundwater

The following are suggested as possible indicators for the conservation of underground waters:

- ✓ Potentiometric map
- ✓ Monitoring of potentiometric levels
- ✓ Chemical monitoring

Soils

The soil type will help to determine the location of plantations. The government has classified all soils in Uruguay into three main classes depending on their proposed use. From the perspective of forestry, these are roughly equivalent to:

- ✓ Forest priority soils – where forestry is most encouraged; these are generally poorer soils less suitable for agriculture
- ✓ Flexible class – where forestry is not a priority but there is flexibility or afforestation if needed
- ✓ Agricultural soils – where forestry is not recommended (although there is no complete prohibition)

There is a debate about whether or not non-forestry soils should be used for forestry: in theory this could boost tree production because at present trees are kept to the poorest soils, reserving good soils for crops. Adherence used to be driven mainly because grants were only available for plantations on designated soil types. The situation is further complicated however because soils that are good for agriculture are not necessarily always the best for trees.

Landscape characteristic of soil units in the plantation landscape

The different soil types in the plantation landscape are described, and for the purposes of analysis are ordered by means of two transects: crossing the department of Paysandú from west to east through the town Lorenzo Geyres and the department of Tacuarembó through the town of Clara; and the second crossing the department of Durazno from west to east from the Palmar Dam.

Table 12: **Main soil types**

Unit	Relief	Soils	Notes
Northern transect: from west to east, Paysandú-Río Negro-Tacuarembó			
Algorta	Gentle slopes (up to 5 per cent)	In extended convex gentle slopes mainly *Planosoles Dístricos* and *Argisoles Dístricos*. In shorter convex slopes mainly *Argisoles Dístricos*. In extended and gentle slopes of higher areas mainly *Brunosoles Subeutricos*	Clear effects of past erosion from agriculture; moderate erosion risk
Bacacuá	Plateaus with gentle slopes and other well-defined steep areas, also rocky hillocks	In higher areas, soils covered by Quaternary formations are *Brunosoles Subeutricos* (sometimes *Eutricos*). *Brunosoles Pseudolíticos* and *Litosoles* are associated. *Argisoles* of the Unit Algorta are common in convex slopes. In stronger slopes, there are *Argisoles* of the Unit Chapicuy	Erosion risk is generally quite low except on steep slopes where it is severe
Chapicuy	Strong well-defined convex slopes and high concave valleys	Most common soils are *Brunosoles Subeútricos* with *Argisoles Subeútricos*. In the E and S *Argisol Dístrico* well drained soils, characteristic red colour	High erosion risk due to slopes and degradation of the superficial horizon. Recently excluded from forestry priority
Curtina	Basaltic soils: no forestry priority soils		
Paso Palmar	As Bacacuá, but for larger scarpes more resistant to weathering	Soils as for Bacacuá	

Unit	Relief	Soils	Notes
Itapebí-Tres Árboles	Basaltic soils, no forestry priority soils		
Queguay Chico	Basaltic soils, no forestry priority soils		
Curtina	Basaltic soils, no forestry priority soils		
Tacua-rembó	Sedimentary non-rocky hillocks, with convex slopes (up to 9%)	The deeper soils, sandy soils are *Luvisoles Ocricos* and *Acrisoles Ocricos* found in the hillocks and higher areas of the slopes. Associated soils found moderately deep in areas with well-defined relief are *Inceptisoles* and *Litosoles*, *Planosoles* in steep slopes	
Rincón de Zamora	Landscape of well-defined hillocks, sometimes short-medium slopes (up to 10%)	Sandy soils in strong convex slopes and non rocky hillocks are *Luvisoles Ocricos* and *Acrisoles* in gentle and steep hillocks (up to 5%) *Ocricos*, *Argisoles Dístricos*; in steep slopes *Luvisoles Melánicos* and in steepish slopes (up to 6%) *Brunosoles Subeutricos*	Little effect of past erosion but a high erosion risk, mainly due to steep slopes, light texture and weak structure in superficial horizons.
Río Tacua-rembó	Landscape of plains in high, medium and low areas; Significant native riverside forest.	The predominant soils are *Gleysoles Lúvicos* and *Planosoles Dístricos*; also *Solonetz Solodizados* and *Fluvisoles Heterotexturales*. In the area of the mouth of the Río Tacuarembó and Río Negro, there are *Arenosoles* that form dunes.	No effect of past erosion and no erosion risk. No forestry priority soils and also identified as important to include in system of protected areas.
Southern transect: from Paso Palmar, crosses Durazno from west to east, to the west end of the department of Cerro Largo			
Bacacuá	Large isolated plateaus with steep-sloped rocky scarps in the borders of large hills.	The soils above the rocky scarp are *Argisoles Dístricos*. When there is Quaternary formation, soils are *Brunosoles Eutricos*. In areas where the Quaternary formation is deep the Merino Unit occurs and no forestry priority	No effect of past erosion and low erosion risk in high areas, above the scarp and very high risk in the slopes below the scarp
Queguay Chico	Basaltic soils, no forestry priority soils		
Baygorria	Basaltic soils, no forestry priority soils		
Curtina	Basaltic soils, no forestry priority soils		
Itapebí-Tres Árboles	Basaltic soils, no forestry priority soils		
San Jorge	Strong slopes, and gentle slopes when there are extended watershed areas	The soils are *Argisoles Dístricos* in strong convex slopes and *Argisoles Subéutricos* in watershed areas	Little effect of past erosion, although large gullies occurring some areas due to a combination of geological process and overgrazing. High erosion risk.
Manuel Oribe	Landscape of non-rocky sedimentary hillocks, except in the north, where sedimentary hillocks are slightly rocky	The soils are *Brunosoles Dístricos* and *Luvisoles Melánicos* in long, gentle slopes. *Luvisoles Melánicos* and *Inceptisoles Ocricos* occur in stronger slopes and superficial *Brunosoles Dístricos* and *Luvisoles Melánicos* in slightly rocky hills	Low effect of past erosion. Significant degradation of superficial horizons of the soil, resulting in degradation of the vegetable cover. High erosion risk; conservation measures needed.

Unit	Relief	Soils	Notes
Blanquillo	Landscape of strong and gentle slopes	The soils are *Brunosoles Subeútricos* and *Argisoles Subeútricos* in strong slopes and *Vertisoles Rúpticos* in gentle slopes.	There is a slight effect of past erosion due to agriculture. High erosion risk.
Aparicio Saravia	Landscape of non-rocky hillocks and a few slightly rocky hillocks	The soils are *Luvisoles Ocricos* (hillocks nearby the Río Negro river); *Luvisoles Ocricos* and *Acrisoles Ocricos* (in slightly rocky hillocks between Blanquillo and La Paloma) and *Luvisoles Melánicos* (near Arévalo).	There is no effect of past erosion. There are some large gullies, but not caused by agriculture. Very high erosion risk
Tres Islas	Steep hillocks and strong slopes	The soils are *Luvisoles Ocricos* in the medium part of convex slopes, *Litosoles* in the high areas (usually with outcroppings) and *Brunosoles Subéutricos* in low areas of the slopes.	There is no effect of past erosion but a very high erosion risk.

The main soil types in the plantation landscape are outlined in the map in Figure 8 below.

Note: we need explanation of this diagram (and a higher resolution version) from the consultants

Figure 8: **Map of the main soil types in the plantation landscape**

Issues for soils under forest plantations

Forest soils can be affected by plantations in three ways, i.e.:

- ✓ Increased erosion
- ✓ Loss of fertility
- ✓ Structural degradation of the soil

Soil pit dug for analysis in Stora Enso plantation in Rio Grande do Sul, Brazil

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Nigel Dudley

Following the same two transects used in defining soil characteristics, critical threats are identified for each of the soil types in Table 13 below.

Table 13: **Critical issues for soils in the plantation landscape**

Unit	Critical issues
Northern transect	
Young	Not forestry priority
Algorta	The physical properties of the soils unit make them suitable for plantations but erosion risks remain and there has been moderate erosion in the past. Virtually the whole unit has been used for agriculture at some time. It will be necessary to adopt and implement soil conservation measures: contour planting, natural drainage areas covered with grass and terraces plus restoration of areas affected by erosion and gulleying plus restoration of corridors (firebreak lanes, extraction paths, etc.) to restore campos. The palm, *Yatay capitata*, is common in the area.
Bacacuá	The critical issues in this unit are the scarpes, unique geological formations that are outstanding landscape features. *Y. capitata* palm trees grow in the scarpe. The same considerations should be applied to this unit.
Chapicuy	Excluded from forestry priority lands but does contain some forestry priority soils. Slopes contain serious erosion including gulleys that prevent use of conventional machinery. Soil erosion is a critical risk and conservation measures will be needed. *Y. capitata* occur.
Curtina	The critical issue at a landscape levels is the existence of excellent quality natural grassland with an important germplasm bank.
Paso Palmar	A forestry priority unit, covering 267,311 ha. Moderately suitable for plantations: soils have restrictions such as sandstones portions in the profile, horizons with high clay and presence of calcium carbonate, usually over 80 cm. Good water availability but also fissures leading to aquifers [recharge?]. There is no forestry priority In the upper part of the unit but above the scarpe border there is a unit without forestry priority formed of agricultural soils *Brunosoles Eútricos*, which may be suitable for plantations. If large areas fall within plantation, they should be included as environmental units. Erosion risk is high in the slopes below the scarpe and very high when those slopes are concave. All planting should use contour lines with controlled drainage. *Y. capitata* appear in the gorges of the scarpes or in the fissures of the stones where they are protected from grazing. It is important to take into account the landscape value of these plateaus.
Itapebí – Tres Árboles	No forestry priority land.
Tacua-rembó	The effect of past erosion is not a generalised phenomenon. A few deep gullies are found in former agricultural land, particularly crops like watermelon, pumpkin and potato. As the superficial horizon is usually over 60 cm deep, corrective measures such as contour planting can be used. Soils are acid and low fertility; management should "contribute" rather than "extract". It is not possible to use this unit without a strict soil conservation system. All crops must use contour planting with parallel lines, making corrections when there are changes in the slope. The area used for the corrections may be devoted to paths or free areas. In *Luvisoles*, with slopes above 8%, terraces designed for each situation must be used. The strip below the canal may be used for extraction paths, as it is drier.
Rincón de Zamora	All soils in the Unit have similar characteristics in the superficial horizon, with a different percentage of sand and are fragile, with superficial horizons of 30 cm on average, light textures and a weak structure. Therefore, erosion risk is high and soil conservation measures must be applied. Contour planting should be used and natural drainage areas be covered with grass. Furrows should not end with a transversal section close to the natural drainage area. When the slope is higher than 8%, use of terraces is recommended.
Río Tacua-rembó	The unit has no forestry priority.
Southern transect: units described in the section above will just be identified	
Bacacuá	See above
Queguay Chico	Unit with much superficial basalt. No forestry priority land
Baygorria	Unit with much superficial basalt. No forestry priority land
Curtina	See above
Itapebí – Tres	See above

Unit	Critical issues
Árboles	
San Jorge	A critical issue is the high erosion risk resulting from light texture and weak structure in the superficial horizon. Therefore, when using the resource, contour planting and natural drainage areas with grass must be used.
Manuel Oribe	The critical issue is the low or very low fertility, although plantations do not usually require special care in this respect. Erosion, and therefore further loss of fertility, is a very important issue. If the erosion risk is controlled, the fertility loss risk will also be under control so that a strict soil conservation system, using contour plantation and drainage areas covered with grass, should be used. Soil protection should take place at the superficial horizon and vegetation cover. When erosion reaches underlying material, large gullies are produced.
Blanquillo	The soils have a high erosion risk and the same management considerations made for the soils in the Manuel Oribe Unit should be applied here. Most of the soils are very similar and the landscape is the same, therefore, the critical issue is the erosion risk.
Aparicio Saravia	The soils always have a layer of pebbles between the horizons A and B. Critical issues to be taken into account are erosion, low fertility and risk of structural degradation. These risks suggest use of soil conservation systems. Contour designs are also important in these soils to improve the storage of water in the profile.
Tres Islas	The critical issues are the erosion risk and the low fertility. Therefore, the crops must be planted using soil conservation systems, mainly contour lines and drainage areas covered with grass.

Impacts from plantations and monitoring change

Transformations in the uses of the soil are important because they are permanent and irreversible. The resulting impacts on the human population in surrounding areas, or in more distant areas, should be taken into account. This effect may be beneficial, and efforts should be made to ensure that this is the case. Sustained production for forestry projects infers a system and an intensity of use of either a natural resource or an ecosystem without degrading it, i.e. keeping its characteristics and values intact and functioning.

Impacts on soils and water resources are two of the risks associated with plantations that generate the highest levels of controversy. They are also areas where careful planning and management can minimise risks, so a process to monitoring biophysical characteristics of the soils and water over time offers a way of both reassuring stakeholders and, if necessary, taking corrective action if problems emerge.

In order to have information on the progress of the project and to monitor the modifications on the maintenance of the ecosystem quality, it is necessary:

- ✓ To establish a network of sites to measure variations in the soil under different production systems (management of the soil resource under the project and under the current natural conditions).
- ✓ To establish a system to determine the productivity variations for each production system (maps based on remote sensors and field verifications to incorporate a GIS of the area of interest)

Both of these will require the identification and measurement of key indicators. Physical, chemical and biological indicators are considered.

- ✓ **Physical indicators**: indicators that refer to soil physical properties, mainly in the superficial horizon.
  - ✓ The ***texture*** indicates the land use suitability, the water storage capacity, the erosion risk and the degradation risk.

- ✓ The ***structure*** provides information to assess the erosion risk and the time suitability for tillage.
- ✓ The assessment of the ***structural stability*** is a very versatile indicator and provides a measure that can be compared with exclusion situations. The analysis of this indicator implies a careful sampling programme inside and outside the project.
- ✓ The ***superficial horizon depth*** (when it is possible to compare with an ideal situation nearby) is an accurate indicator of the effect of past erosion. It may also participate in the assessment of the land use suitability and the water storage capacity

✓ **Chemical indicators**: parameters that affect directly the development of the project or the soil degradation risk should be taken into account as indicators.

- ✓ ***Soil acidity*** is a universal indicator. The crops indicate the acceptable range for a successful implementation and development
- ✓ The existence and depth of ***calcium carbonate*** may be an effective indicator, as it may limit the implementation of a crop or variety
- ✓ The ***exchange capacity*** is a very valuable indicator, as it indicates the profile fertility. The systematic use of this indicator implies having access to a laboratory with the equipment needed for this analysis in the long term

✓ **Biological indicators**: linked to the percentage of soil organic matter, a parameter that has a strong influence when establishing a plantation. Other biological indicators must be considered in the framework of multidisciplinary teams, as multiple organisms are part of the ecosystem at soil level

It should be noted that studies suggest that many soils in Uruguay are likely to undergo increased erosion under projected climate changes, including greater rainfall (Victoria et al 1997).

To come – analysis of rainfall data: Note that in the past, doubts have been raised about the accuracy of rainfall data in Uruguay (Silveira 1997).

Silveira, L. 1997. Multivariate analysis in hydrology: the factor correspondence analysis method applied to annual rainfall data. *Hydrological Sciences Journal* **42** (2): 215-224

The Biological Environment

Issues relating to biodiversity and plantations are some of the most important of all for Stora Enso in terms of global opinions but paradoxically the least of the concerns amongst many stakeholders within the country. This is by no means an unusual situation for a global company with their home base in a country with a high level of awareness of conservation.

The following analysis starts by looking at the ecological history of Uruguay, to provide some background about the type of environmental conditions likely to be found and then proceeds to a series of landscape characterisations from the perspective of major flora and fauna groups. The study focuses on those plant and animal groups likely to be of most interest and also most representative of the ecosystem as a whole.

Senecio mattfeldianus

Ecological history of Uruguay

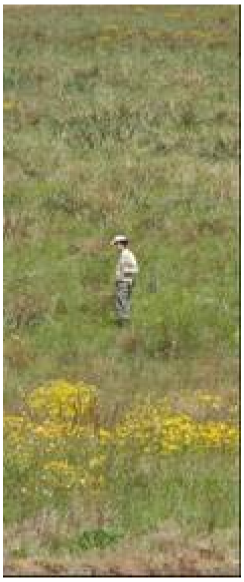
Given that plantations will cause major changes to ecology, it is important to understand the changes that have already taken place to the ecology of the country. Knowledge of Uruguayan ecological history remains poorly understood and the following account covers the whole of the country.

Uruguay is naturally dominated by scrub and grassland ecosystems

As far as we can tell, most of Uruguay is naturally dominated by scrub and grassland ecosystems, with much smaller areas of high forest and wetland. Natural grasslands are diverse and ecologically important, although centuries of agriculture have changed their ecology and degraded their environment – the original ecosystem would have looked radically different to that found today. Although over-grazing is undoubtedly a major pressure on remaining natural grasslands, complete absence of grazing is also likely to lead to losses of diversity in herbaceous species.

Grassland

The campos grassland[1] is a sub-humid sub-tropical grassland ecosystem with few large trees occurring naturally except close to rivers and streams. It lies between 24°S and 35°S; and includes parts of Brazil, Paraguay and Argentina, and all of Uruguay, covering approximately 500,000 km^2. Most of the area falls within the *Uruguayan savannah ecoregion*, a 355,000 km^2 area covering parts of southern Brazil, northern Argentina and most of Uruguay (Locklin 2001). In addition to the dominant grassland, the region contains a mosaic of gallery forests, palm savannas and out-cropping of sub-montane forests. Within the campos there are various different grassland habitats, determined by soil properties, water content and elevation (although the whole country is low-lying), with species and ecology now also heavily influenced by grazing pressure and, at least historically, probably also by the presence and frequency of fire. Generally, grassland today varies between tussock grass and short grass communities, with the latter generally being encouraged by heavy grazing. Different species mixtures are likely to remain depending on whether sheep or cattle are on the pasture. There is a marked difference in species between the north and south.



The campos grassland is a sub-humid sub-tropical grassland ecosystem with few large trees occurring naturally except close to rivers and streams

Rainfall is evenly distributed through the year but subject to marked annual fluctuations; there is high humidity in the spring and autumn but evapotranspiration exceeds rainfall during the summer.

The Uruguayan grasslands support about 400 species of annual and perennial grasses, making the area exceptionally rich in grass species (some 4 per cent of the global total). There are also numerous herbaceous species. However historical grassland would not have looked much like the pasture found in most of the country today but would instead have been dominated by shrubs growing up to 3 metres tall. The dominant shrub species return very quickly if grazing stops or is reduced and can be seen emerging quickly in abandoned fields and along roadsides, where they have to be controlled. The areas now dominated by tall or short grasses would in the past have resembled more closely a savannah as it is understood in Africa. Exceptions, where short grass species would have remained dominant, are found naturally on some particularly wet soils or very thin soils where larger shrubs have difficulty in establishing.

[1] The grassland is often known as *pampas*, particularly outside Uruguay. Strictly speaking, *campos* is sub-tropical while pampas is temperate grassland, generally identified as starting further south in Argentina. There is considerable overlap of species.

Natural woodland now only covers 3.8 per cent of the country

Nigel Dudley

Woodland

Woodland is the other major habitat in the country, but is comparatively limited in extent. Much woodland has been lost as a result of human actions (Carrere, 2001) and natural woodlands now cover only 3.8 per cent of the country (670,000 hectares) according to a survey carried out in 2000 (FAO, 2000). Both natural woodland and palm savannah are protected, although the latter is currently suffering problems from lack of regeneration due to cattle grazing (Locklin 2001).

There are 74 mammal species in Uruguay along with 404 birds, although both groups tend to be concentrated in wetlands and river forests (Nores et al, 2005); around 80 species of birds are found in grassland (Locklin, 2001).

Ecological history

Comparatively little is known about the ecological history of Uruguay prior to the introduction of cattle and horses at the beginning of the 17th century. Reports by travellers such as Charles Darwin suggest that already by the beginning of the 19th century there were few forests except along rivers and the country was dominated by a savannah landscape with occasional trees and shrubs.

A limited amount of pollen analysis has been carried out within the wider ecoregion, suggesting that the ecology is naturally dominated by grassland, albeit now heavily modified by human impacts. A study in the lowlands of Rio Grande do Sul in southern Brazil, in a similar habitat to that of the grasslands of Uruguay, concluded that that the Campos region was naturally covered by savannah grassland during the full- and late-glacial periods, during which time riverside forests were absent. Exceptions were a few isolated trees along rivers, and in addition more extensive forest developed during the post-glacial period. Riverside forests started to spread during the late Holocene, both along rivers and also in some wetter, lowland areas, reaching a maximum extent around a thousand years ago. But by then there were also humans living in the region and records suggest a marked increase in fires at this time, which were probably anthropogenic, although an increase in both temperatures and in frequency of dry periods during this time would have also favoured more fires (Behling et al 2005).

Land use

About 80 per cent of Uruguay is used for cattle ranching on both natural and increasingly also on artificial grasslands. In 1996 there were an estimated 13 million cattle in Uruguay (Pallarés et al 2005). Natural grassland (neither cultivated fields nor artificial grasslands) occupy approximately 14 million hectares (Biodiversity Planning Support Unit 2001). Increasingly these are being replaced by exotic species and artificial grasslands increased by 32 per cent between 1980 and 1990 in Uruguay (Republica Oriental del Uruguay et al 1992). Natural grassland that has retained a wide range of species is particularly valuable from a biodiversity perspective. There have, as yet, been few studies comparing richness of animal diversity with naturalness of grassland. Exotic plants, including many from Europe, have also been introduced and in some cases these have changed the nature of the grasslands.

The evolution of the Uruguayan campos since the days of the first European settlements is said to involve three main stages (Panario and Bidegain 1997):

- ✓ 'hardening' as a result of the introduction of livestock
- ✓ 'refinement' by the action of fire and overgrazing
- ✓ further degradation, including preferential development of warm-season species, due to persistent overgrazing

Over-grazing has changed the ecology even in many apparently natural grassland habitats. In addition it was estimated that 53 per cent of agricultural land received application of fertilizers in 1992 (Republica Oriental del Uruguay et al 1992) and application of pesticides is also increasing. In general, analysis of the grasslands of southern Latin America found that crop production has been a key factor in their fragmentation (Baldi et al 2006).

Restoration of original habitats

Given the continued lack of detailed knowledge about vegetation history, full restoration is not currently possible. However, several experimental studies have excluded grasslands from grazing for a period of years and the impacts have been recorded.

Virtually all the grassland in Uruguay has been changed by cattle and sheep grazing; in natural conditions there would have been far more scrub and bushes.

An area of grassland was fenced off in 1984 to exclude grazing from land that had previously been grazed for centuries. Short grasses declined and taller bunch-grasses emerged along with shrubs. The continued exclusion of grazing led to increased litter accumulation, which changed the moisture retention capacity of the soil and, coupled with the effects of taller grasses, modified the microclimate (Pallarés et al 2005). A nine-year exclusion project on natural grassland found similar changes towards tussock vegetation and also an increase in annual species, while there was also an increase in annual herbaceous species and nitrogen-fixing species. However, general species richness and diversity decreased over the period (Rodriguez et al 2003). These results were later confirmed by comparing with natural and artificial grazing (Altesor et al 2005). A survey of seven continuously grazed and ungrazed paired plots included analysis of impacts on soil, fauna and flora. Species numbers were lower in ungrazed plots (with 70 species in enclosures and 105 in grazed areas). Grazing considerably altered species composition, with an increase in prostrate, warm season species and a decrease in shrubs with grazing (Altesor et al 2006).

The bushes that would naturally dominate much of the campos spring up wherever there is no grazing pressure – for example they have to be cleared from roadside verges

Nigel Dudley

Although virgin campos (grassland which has never been under crops) is identified as a distinct habitat type, it is said to be indistinguishable from former cropland once the latter has been through a ten year recovery period, suggesting a high level of resilience within the system (Boggiano per comm. 2007)

Uruguayan scientists are building up an understanding of the changes that are likely to have occurred through introduction of cattle (which have to some extent displaced natural grazers such as deer) and of optimal levels of grazing to maintain species diversity. A full understanding of ecology before European settlement is by now probably impossible and in any case it seems likely that humans have been present since current climatic conditions existed so that a "pristine" environment without human influence has probably never existed in the form it would today.

Protected area network of Uruguay and conservation priorities

The Uruguayan savannah is one of the least protected ecoregions in South America.

The Uruguayan savannah is one of the least protected ecoregions in South America (Soutullo and Gudynas 2006). The protected areas system is under-developed with a reported 0.4 per cent of land in some kind of protected area (Earthtrends 2003), although it is not clear if this figure includes proposed protected areas as well those officially designated. There is currently a commitment by the Government to develop the protected areas system, which is included in its goals under the Millennium Development Committee, and an implementation grant from the Global Environmental Facility has been received.

Existing and proposed protected areas

Many of the current protected areas are small, with the exception of a large wetland site to the far east of the country, which is under multiple use practices. Most protected areas have not been assigned an IUCN category of management objective (there are six categories distinguishing management types ranging from strict protection to multiple use) and details on the World Database on Protected Areas remain sketchy. Uruguay has protected areas listed under the Ramsar Convention (for important wetlands), UNESCO Man and the Biosphere programme and UNECO World Heritage sites. There are also a number of state and private protected areas. No major protected areas fall within the plantation landscape. Details of existing protected areas are summarised below.

Ramsar: there are two wetland sites listed under the Ramsar Convention.

- ✓ **Bañados del Este y Franja Costera** in Rocha covers 407,408 ha, sharing a border with Brazil; a vast complex of coastal wetlands including lagoons and parts of several rivers. It is important for locally nesting shorebirds and migratory shorebirds. It was added to the **Montreux Record**, indicating that the Ramsar Committee regards it as being at risk, on 4 July 1990. The site is also the only UNESCO Man and the Biosphere reserve in Uruguay.

- ✓ **Esteros de Farrapos e Islas del Río Uruguay** covers 17,496 ha in the lower Uruguay River. The site consists of alluvial areas on the river's eastern bank and 24 islands, which are occasionally flooded. The system is important for the control of floods and erosion. Elevated sand bars support forests and permanent and intermittent freshwater pools. The larger part of the area is owned by the State, and its most abundant use is extensive summer cattle grazing, although there is also coal mining and, horticulture and citrus production.

World Heritage: there is only one World Heritage site in Uruguay, the old town of Colonia, which is a cultural site and therefore not of relevance in the sense of biodiversity conservation.

Table 14 overleaf summarises details of most of the current protected areas in Uruguay, excepting arboreta and historical sites.

The World Database of Protected Areas also lists fifteen more “recommended” sites that have not yet been designated; some of these are quite large and two – Bosques y Bañales del Yaguari and Cuchi de Haedo – may fall within the plantation landscape. In addition, it has been proposed that islands and sand dunes in the Rio Negro could be possible candidates for protection, some of which are within both the wider landscape and lands that Stora Enso currently owns.

Table 14: **Protected areas in Uruguay**

Name	Size (ha)	IUCN category
National parks		
✓ Anchorena	1,370	
✓ Arequita	1,000	II
✓ El Potrerillo de Sta. Teresa	715	
✓ Fortaleza de Sta. Teresa	3,290	
✓ Franklin Delano Roosevelt	1,492	
✓ Fuerte San Miguel	1,553	VI
✓ Isla de San Gabriel	24	
✓ Islas Costeras	70	
✓ Islas de Río Negro	1,859	
✓ Lacustre	15,250	
Wildlife reserve		
✓ Laguna de Castillos	8,185	
Reserve		
✓ Isla de las Gaviotas		
Protected natural area		
✓ Quebrada de los Cuervos	366	
Parks		
✓ Andresito Park	162	
✓ Bartolome Hidalgo	188	
Multiple-use area		
✓ Lagunas de José Ignacio, Garzón y Rocha	15,250	
Flora and fauna reserve		
✓ Potrerillo de Sta. Teresa	715	
Forest reserves		
✓ Arboretum de Lussich	300	
✓ Cabo Polonio y Aguas Dulces	6,000	
Municipal reserve		
✓ Quebrada de los Cuervos	400	
National forest		
✓ Islas Fiscales del Rio Sta Lucia	550	
✓ Islas Fiscales del Río Uruguay	6,600	

Private reserves

The idea that private reserves, including those on company-owned land, could be more fully integrated into national protected area systems is one that IUCN is anxious to explore.

The IUCN definition of a protected area explicitly recognises the role of protected areas outside state control, including private reserves.

The IUCN definition of a protected area – *an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means* (IUCN 1994) – explicitly recognises the role of protected areas outside state control including private reserves, community conserved areas and co-managed areas. The number of company-owned protected areas is increasing rapidly, in part because of obligations by some of the forest certification systems to maintain part of land under protection. Options for including set-aside areas of plantations within protected areas in Uruguay is explored later in the report.

Conclusions: conservation priorities

Temperate grassland remains one of the least protected ecosystems on earth, in part because its high value as pasture has caused major changes and also created reluctance to set aside protected areas. Recently there has been increasing attention on the conservation implications of this, with for example a major report recently appearing from FAO (Steinfeld at al 2006). By consciously focusing on the needs of campos conservation Stora Enso could be leading the way in what is likely to become an increasing global priority. Involvement in a private reserve on company land would be a major achievement in terms of driving forward private-public partnerships in conservation.

Flora

We have already noted that historical management has created major changes in the ecology of Uruguay. Despite this, a rich flora remains in remnant patches of semi-natural habitats and in the large areas of campos. As part of the assessment, specialists on forests, wetlands and grassland identified key issues of importance.

Background – the flora of Uruguay

The vascular flora of Uruguay includes 2,500 species grouped in 811 genera and 150 families (Marchesi 2005). Uruguay has a medium to low richness of endemic species.

Grasslands occupy 70 to 80 per cent of the country; forests and woodlands, 4 per cent and other vegetation types even less. Only around a hundred plant species are classified as endemic to Uruguay and many of these are in fact probably present undetected in neighbouring countries. Although some authorities classify Uruguayan grassland with the pampas found in Argentina, others separate Uruguay and southern Brazil into a different *campos* sub-region (e.g. Grela 2004), differentiated in part by the presence of more trees and shrubs and also different grass species. Furthermore, within the *campos* sub-region, Soriano et al (1991) distinguish between the subtropical flora in the north, which are gradually replaced by flora of colder and dryer areas in the south. Grela (2004) suggests a different division based on distribution of woody species, distinguishing the western area along the Rio Uruguay (*occidental flora*) and the eastern and north-eastern area of the country (*oriental flora*).

Identifying hotspots for flora

Some initial efforts have been made to identify biodiversity hotspots (Myers et al 2000) using flora. The analysis is primarily based first on the presence of tree and shrub species, because their phytogeography is relatively well understood. From this perspective, the Uruguayan woody flora is a southern extension of the Paranaense Province in the east and a south-western extension of the Chaqueña Province in the west: in both cases being at the limit of the typical species of these phytogeographic provinces. Three forest areas can be identified (see Figure 9):

- ✓ Forests to the west (Chaqueña-Parense transition) are typical of woodland extending into Argentina, SE Paraguay and southern Bolivia and are thought to indicate a more arid climate in the past.
- ✓ To the east in the Parense province, "domain of seasonal forests", are mainly river forests and Uruguay is again at their southern limit.
- ✓ Less well known, is the woody flora of the *cerros chatos* (flat hills) in Rivera, which may be part of the flora of Cerrado Province in Brazil.

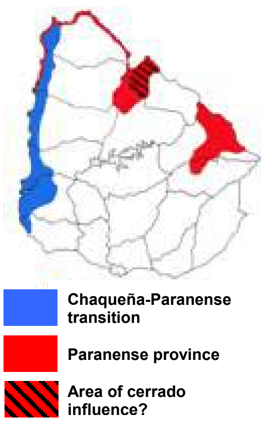


Figure 9: **Main forest areas in Uruguay**

Drawing on data for woody species and inferring a corresponding richness in other groups, the following hotspots have been suggested (Grela 2004) – see Figure 10 overleaf. Using this analysis, it seems that the most important hotspots from the perspective of woody species are not included in the plantation landscape. However, this part of Uruguay is also one of the least studied from a botanical point of view and some of the typical species of areas of endemism may yet be found, e.g. "*monte capón*" (isolated forest not associated with any water body), riverside forests, etc. Figure 11 shows the origin of herbaria collections of woody species and grasses in Uruguay and the lack of information from the centre of the country is very evident. The Stora Enso plantation landscape is also in a transitional area between the flora of the sub-tropical north and the cooler south.

To check: need better explanation of colours on Figure 10

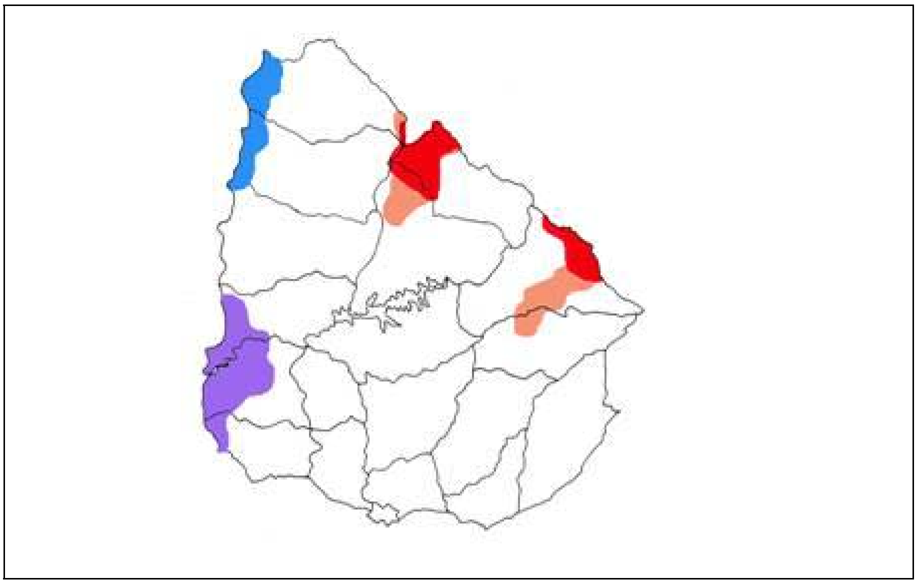


Figure 10: **Main concentrations of woody species with restricted distribution (areas of endemism), plus high biodiversity of other species – which can be considered as hotspots** (adapted from Grela 2004)

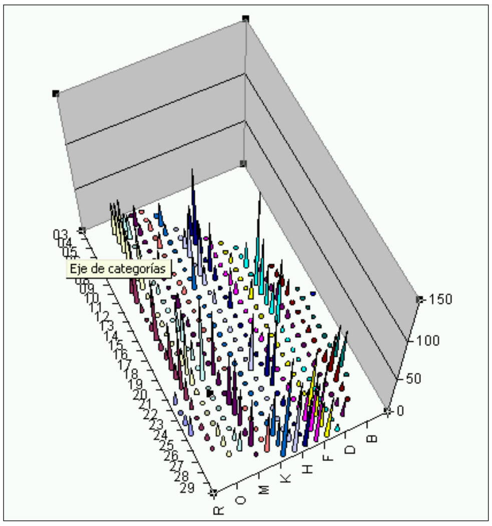


Figure 11: **Graphic representation of sampling effort through the number of grass species reported from different areas of Uruguay in herbarium samples. Collection bias of is evident given that this type of species is present in the whole country**

For this reason, hotspots are still not a comprehensive tool for planning in Uruguay and decisions about floral richness need to be made on a case by case basis.

Main vegetation habitats in Uruguay

Grassland

Botanists draw an important distinction between grassland that has only ever been used for grazing and grassland that has at some time been ploughed for crops.

All campos is marked by the presence of few trees or shrubs, although shrubs are usually only repressed by grazing. Botanists draw an important distinction between grassland that has only ever been used for grazing and grassland that has at some time been ploughed for crops. ***Campo virgen pastoreado*** (virgin pasture) has never been used for crops. The structure and composition of the flora depends mainly on soil type and previous grazing. Annual or perennial exotic weeds are absent or very scarce, sometimes associated with roads, paths or salt feeding places. Rosengurtt (1975), identified several indicator species of virgin campos, as they disappear after the disruption caused by agriculture, e.g. *Agenium villosum, Anemone decapetala, Discaria longispina, Dorstenia brasiliensis, Eryngium sanguisorba, Geranium albicans, Pavonia hastata, Psidium* *luridum, Shizachyrium imberbis, Trixis brasliensis, Criscia stricta*. Long-lived perennial species dominate, forming intricate arrangements of tillers and stems. The conservation and management of these habitats is important because they include a significant floral diversity and a great genetic variability within populations of the most important productive species. The proportion of this type of campos has decreased over time. However, a number of transition phases are identified between abandoned crop-land and virgin pasture depending on time since cultivation:

Fields gradually recover natural vegetation patterns a number of years after crop planting ceases

Nigel Dudley

- ✓ **Stubble**: immediately following crops
- ✓ **New grassland from stubble**: one or two years after crops, when grazing has reduced annual weeds and short-cycle perennial species start to predominate
- ✓ **Rough grassland**: 4-6 years after crops, long-cycle perennial species have colonised the area. Short-cycle perennial species are still abundant
- ✓ **Established grassland**: after 10 years it is hard to distinguish from a virgin field (usually by non-biological indicators e.g. ploughing ridges or plot markers) and grazing has reduced or eliminated short-cycle perennial species.

Within established grassland habitats a number of varieties are distinguished depending on substrate:

- ✓ ***Campos pedregosos*** (stony fields) occur where rocky outcrops cover a significant part of the surface, ranging from bare or lichen-covered rock to a stable vegetation cover with a thin soil layer. Stony fields are relatively unstable habitats and liable to evolve into another kind of vegetation types dominated by trees, shrubs, cactus and bromeliad species.
- ✓ ***Campos arenosos*** (sandy fields) develop on soils with abundant sand, varying from dunes to soils with a relatively high content of organic matter.
- ✓ ***Campos de bañado*** (wetland fields) are found in flooded areas soil with high permanent or semi-permanent moisture content and include **uliginose grassland** with deep soils and water available all the year and **paludose grassland** with high soil water content and longer flooding periods

Grassland can be further divided depending on soil type: this is described for the specific soils found in the Stora Enso plantation landscape on page ##.

Forest

As with grasslands, different classification systems have been suggested and the following typology is not fixed as overlap occurs between types.

- ✓ **River forests** or gallery or riparian forests: Strips of woodland associated with rivers and streams. Trees are tall and thick, and the canopy completely covers the ground, sometimes with more than one layer.
- ✓ **Serrano forests** or mountain forests: associated with rocky hills and varying from complete cover to isolated small groups of trees on slopes. Trees tend to be stocky, without defined strata.

✓ **Gorge forests**: large trees, several strata, and usually a diverse herb layer, particularly of ferns.

✓ **Maritime forests**: xerophytic forests, very stocky and thorny, dominated by short species including some of those present in *serrano* and river forest. Found on the coastal strip of the Atlantic Ocean and the De la Plata River.

✓ **Mesquite forests**: thorny forest with a high layer of leguminous species, plus other trees, shrubs and palms (usually thorny) and usually a large herb layer.

✓ **Palm tree groups**: grassland or shrub habitat usually with one species of associated palm. There are two main species: *Butia capitata* and *B. yatay. B. paraguayensis* also occurs on small hills and sandstone hillocks.

✓ ***Capon* forests**: small forests located in low areas forming "islands" of forest surrounded by grassland, associated with small ravines or swampy areas. Floral diversity may be very rich.

✓ **Forests of flat hills**: associated with sandstone cornices forming flat hills in Rivera and Tacuarembó, trees are usually stocky but not thorny. *Butia yatay* may be present.

Figure 12 shows the area where the main types of woody vegetation are present.

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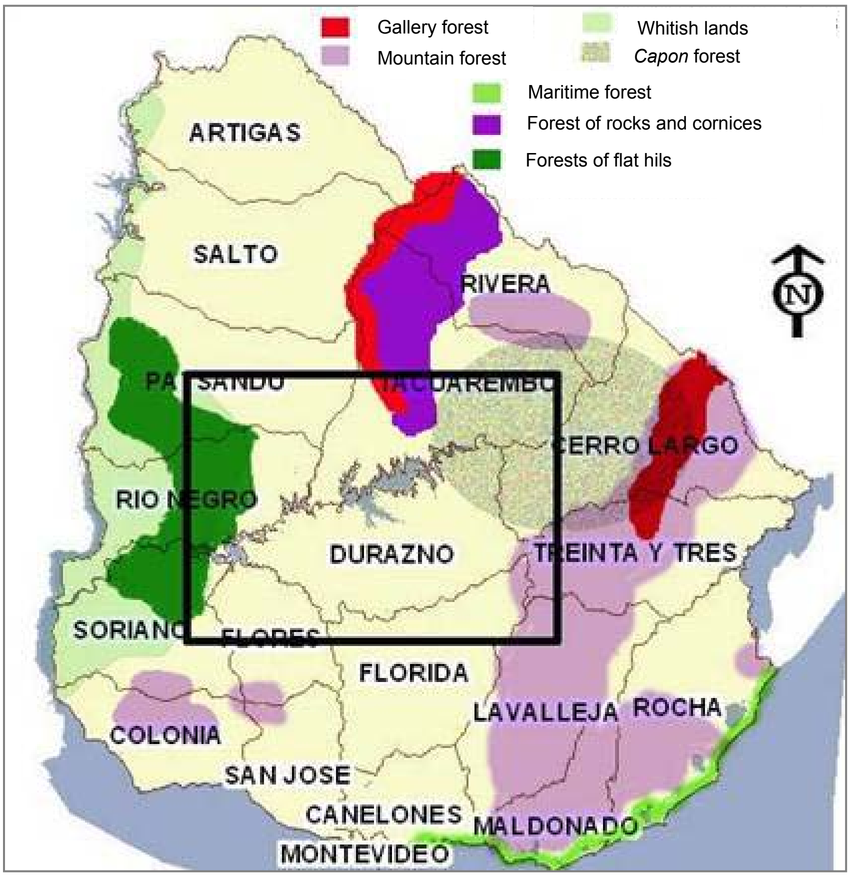
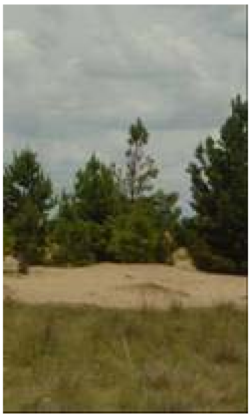


Figure 12: **Location of main woodland areas in Uruguay.** Not shown are riverside forests (present in all the country); groups of palm trees; and small areas of *serrano* forests associated with crystalline basement outcropping in the centre and south-western areas. Shaded areas indicate places where the vegetation represented is present; it does not mean it predominates. Main plantation area in the box (approximate)

Other vegetation types in Uruguay

- ✓ **Wetlands and marshes**: found mainly in lowland areas with permanent or at least semi-permanent flooding. They are usually highly productive ecosystems with specialised vegetation and their soils have poor aeration and high organic matter content. Much smaller (and also less well studied) areas, which are nonetheless very important from the floral point of view, occur in low sandstone areas in Rivera and Tacuarembó. Small acid wetlands or marshes are formed next to water courses, with the only Uruguayan location of several species more typical of warmer areas of the Amazonic Domain. In addition to a range of vegetation assemblages (many of which will be single-species stands) wetlands also merge into transition habitats.

- ✓ **Pajonales**: forming intermediate habitats between campos and riverside forests or wetlands, dominated by large tufted grasses. These areas are frequently burnt to create new shoots for cattle, without apparently causing major damage to the system.



Vegetation of sandy inland sites is quite specialised and still poorly understood – some of this is planned to be within protected areas.

Near Rio Negro Nigel Dudley

- ✓ **Herbaceous and shrubby formations**: intermediate between grassland and shrubs, common on the flat hills of Rivera and Tacuarembó, often with rocky outcrops. There is more bare soil due to the greater presence of tufted grasses and other upright species with little ground cover.

- ✓ **Vegetation of sandy sites**: sand dune complexes on the banks of the Rio Tacuarembó, Negro and Yi are unusually large for inland areas of Uruguay and contain specialised species with deep roots, stolons and rhizomes. Clear successions can often be seen as vegetation stabilises and changes the soil. Inland dunes remain poorly studied.

- ✓ **Vegetation of rocky ground**: variable habitats with changing micro-climatic conditions and specialised vegetation. Examples of this type of vegetation are the cornices of different geological origins in Río Negro and Paysandú (Cretaceous), Durazno and Cerro Largo (Devonian and Permian), and Tacuarembó and Rivera (Jurassic). These areas are often important from a conservation perspective as they may include field species that have disappeared from other sites as a result of management.

Flora in the Stora-Enso plantation landscape

The area of the proposed plantation is not well studied. What follows is an overview of what is known; followed by some informed speculation about what may be expected within the area but has yet to be recorded.

To check: do we need this list? The section is already rather detailed…

Main grassland types in the Stora-Enso plantation landscape

Because most vegetation is either unsuitable for trees or protected by law, the main impacts of the plantation, in terms of replacing natural or semi-natural habitats, will be on *campos*. This is therefore described in greatest detail. The following types occur, described by their CONEAT number (the government soil classification system) based on soil type.

- ✓ CONEAT Group 1: **Superficial basalt fields**: the first grasses to colonize here are those that resist the acute summer water deficit, e.g. annual winter grasses and low productivity summer grasses with low dry matter production.

- ✓ CONEAT Group 12: **Deep basalt fields**: vegetation in deep soils is dense and thick, including productive perennial species with little uncovered soil. Summer species cover up to 80 per cent of the ground. Common hard grasses coexist with high quality grasses, requiring care to avoid overgrazing the most palatable species.

- ✓ CONEAT Group 10: **Deep crystalline fields**: common productive grasses dominate in campos on crystalline ground in the centre of the area. Hard grasses are frequent and may predominate. Other herbaceous species are relatively important, but leguminous plants are less common.

- ✓ CONEAT Group 5: **Superficial crystalline**: the most superficial soils have naked soil areas and a high number of winter annual grasses. *Sellaginela* sp (Sellaginelaceae-Briophyta)*, Chloris grandiflora, Microchloa indica* and *Tripogon spicatum* are typical species of the initial stages of soil formation.

- ✓ CONEAT Group 2: ***Sierra des Este* fields**: vegetation is varied, with thin summer grass predominating and shrubs, *serrano* forest, xerophyte communities and sometimes riverside forest associated. The canopy is open.

- ✓ CONEAT Group 7 and 8: **Sandy fields**: vegetation is mainly composed of perennial summer grasses and some winter species and native legumes.

- ✓ CONEAT Group13: **Yaguarí heavy field soils**: summer grasses dominate in campos on the north-east. Winter species are frequent in slopes with heavier soils. Campos is sometimes are covered by small shrubs or even native trees.

- ✓ CONEAT Group 9.6: **Fields on cretaceous sediments**: Summer species dominate. Despite this, winter forage production is quite high, due to the contribution of winter Cyperaceous, e.g. some *Carex* species

- ✓ CONEAT Group 11: **Natural fields with park vegetation**: High quality, tender, winter and summer species are both present, combining excellent production of natural grassland with the protection offered by trees. Winter species become more dominant as the internal drainage and fertility increase.

Although the plantation will be established on grassland, conservation of other vegetation types inside the plantation estate will also be important.

Other types of vegetation in the plantation landscape

Besides campos, the following habitats occur and need to be considered in forest management. Vegetation is highly associated with geology and geomorphology. A good interpretation of geological characteristics will help understanding of flora. The main habitats of interest are listed in Table 15 below, along with their locations in the region.

To check
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Table 15: **Flora of key habitats in the plantation landscape**

Habitat	Location and notes
Riverside forests	Found throughout. Those associated with the Rio Negro, Tacuarembó and Yí are the most developed and extended. The springs of the Queguay Grande and Queguay Chico rivers (tributaries of the Rio Uruguay) and the Salsipuedes, Malo and Cordobés streams (tributaries of Rio Negro) are other watercourses with important forests. Other specific forests associated with smaller water courses may also have interest due to particular characteristics (topography, development and conservation status, etc).
Serrano forests	Scarcely represented, may be present in some areas of granitic outcrops in the southern part of the study area (Durazno, Florida, Flores) and towards the east (Cerro Largo).
Gorge forests	Occur in Tacuarembó

Habitat	Location and notes
Algarrobales or park forests	Probably present in the eastern side of the study area (Rio Negro and Paysandú) associated with areas of cretaceous sandstone outcrops, although the plantation landscape does not include the largest areas of this type of vegetation.
Mesquite forest	The main areas of occurrence are Rio Negro and Paysandú
Butia yatay palm tree groups	This particular vegetation formation may be present in establishments located in the western limit of the study area, particularly around Guichón (Paysandú) and also in Rio Negro
Vegetation of small hills and rocky ground	Difficult to represent in maps due to the small individual areas involved, but found in areas covered by sandstone formations in the study area in Durazno, Cerro Largo and Tacuarembó (Permian and Triassic sandstones) and Río Negro and Paysandú (Cretaceous sandstones). These areas have high species richness and are of special interest for conservation. It must be noted that the flora associated with each of the two types of sandstone is very different.
Capon forests	Similar restrictions apply as above. They are mainly found in the area of Permian sandstones of San Gregorio-Tres Islas, eastern Durazno, Cerro Largo and southern Tacuarembó and are areas of particular interest for conservation.
Wetlands and marshes	Wetlands may occupy large areas in lowlands associated with the main water courses already mentioned, or smaller areas associated with natural drainage areas, river and stream-sides or *capón* forests.
Sandy sites	These are mainly associated with the final segment of the Rio Tacuarembó, and the Rio Negro and Yí. They are not always found next to the current banks, but can be large deposits somewhat distant, maybe as a result of paleobeds or mobile dunes. These communities have been little studied from a floral and ecological point of view. However, they are very fragile and therefore have a high conservation value

Because the area has been so poorly surveyed for botany, the experts also made some informed speculation about what is likely to occur there but has yet to be recorded.

Likely additions to the flora

Most of the area of interest for the project of Stora Enso is outside the main areas of phytogeographic endemism of woody species. However, there are areas of endemism nearby and given the lack of research to draw upon; it is likely that rare and endemic species will be found within the plantation landscape. The following series of paragraphs makes some informed speculation about what is likely to occur there.

- ✓ The eastern limit of the "*Chaqueña*" flora, including *Butia yatay* palms, reaches the western part of the plantation landscape. Park forests (for instance *Prosopis affinis, P. nigra, Aspidosperma -quebracho-blanco-, Geoffroea decorticans, Trithrinax campestris,* etc.) and other associated herbaceous species could be present. Surveys carried out in the west have detected rare or restricted distribution species, both in areas of "*blanqueales*" (alkaline soils) or cornices of cretaceous sandstone, where the flora is completely different from that associated with the sandstones of San Gregorio-Tres Islas, Tacuarembó, and Rivera.

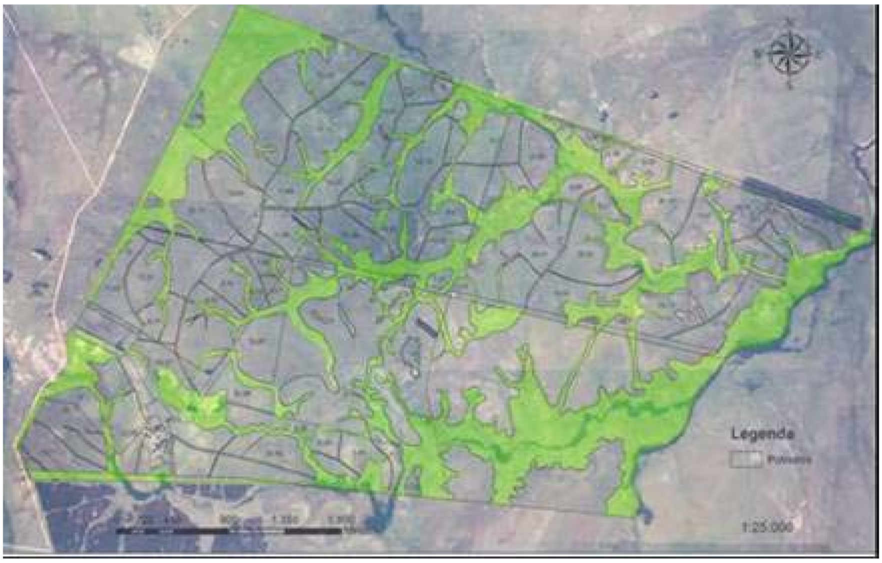
- ✓ The northern limit of the plantation landscape reaches the southern limit of the gorges and flat hills of Tacuarembó. Several species typical of the north-eastern sub-area of endemism may be present, for example woody species such as *Ilex paraguariensis* (Yerba mate), *Banara umbraticola, Ocotea pulchella, O. puberula* and *Quillaja brasiliensis*. Personal communications (not recorded in herbarium samples) mention the presence of at least two rare or very rare species of ferns: *Dicksonia sellowiana* (arborescent fern included in the Appendix I of CITES) and *Niphidium crassiflorus* of which we have detected only two populations in Uruguay (Sierra de Ríos in Cerro Largo).

- ✓ The flat hills in Tacuarembó apparently have a lower diversity than those of Rivera; but they have been less surveyed and some species thought to be exclusive to Rivera may also be present. In this common area between the basalt and the sandstones, the landscape factor must be considered, given that hills and cornices, small gorges, are typical elements of the area.

- ✓ Finally, to the east, the area reaches the limit of the gorges and *capon* forests. Although gorges are mainly present in the granitic areas (outside the study area), these species may occur in the isolated *capon* forests and gorges in the landscape of western Cerro Largo and north-eastern Durazno (beside the Arroyo Cordobés stream) associated with sandstone formations (particularly San Gregorio-Tres Islas). These environments are favourable for very diverse vegetation due to the abundant water content. They have not been studied thoroughly from a floral point of view, and many rare or infrequent species (particularly ferns) may be present.

Conclusions

The flora of the region is relatively poorly known; whilst not being unmongst the richest in the country it contains interesting assemblages and species and it is likely that more discoveries are yet to be made – the research both summarised current knowledge and gave informed speculation about what else might be present. Important issues for Stora Enso will rest on identifying the most important grassland habitats and conserving these, although other residual habitat types of interest are also listed and described; a number of these already receive legal protection. Management of vegetation outside the plantation itself is a critical facor in maintaining biodiversity.



The specialists have surveyed the estates already bought by Stora Enso and mapped the flora, as here at Las Tias

Fauna

The overview includes information on mammals, birds, reptiles and amphibians and key invertebrate groups.

Mammals

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A survey was made of the diversity of large terrestrial mammals recorded in Durazno, Tacuarembó, Río Negro and Paysandú, in order to identify hotspots of species richness (Myers et al 2000) and potential indicator species. It drew on bibliographic material from the Institute of Biological Research Clemente Estable, University of the Republic and the National Museum of Natural History, Uruguay (Achaval et al 2004, Mones et al 2003). A diagnosis file was created online for each species in order to update data, including geographical distribution, existing records, and conservation status of the species relating to the IUCN Red List of Threatened Species, CITES and national legislation.

Distribution of mammal species in the landscape

Of the 119 mammal species recorded in Uruguay, 68 per cent are terrestrial, 5 per cent aquatic and the remainder marine: 60 per cent are classified as large mammals with a body weight greater than 1 kg. In total, the study examined 34 large terrestrial and aquatic species (Achaval et al 2004), all but four of which are native. All the large mammal species are found in the study region and their distribution is outlined in Table 16 below.

To check
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Table 16: **Historical distribution of large mammals in the plantation landscape**

Species	Durazno	Tacuarembó	Río Negro	Paysandú
D. albiventris	Dark blue	Dark blue	Dark blue	Dark blue
D. hybridus	Dark blue	Dark blue	Dark blue	Dark blue
D. novemcinctus	Dark blue	Dark blue	Dark blue	Dark blue
E sexcinctus	Dark blue	Dark blue	Dark blue	Dark blue
M. tridactyla	Dark blue			
T. tetradactyla		Dark blue		
A. axis			Dark blue	Dark blue
B. dichotomus			Dark blue	
O. bezoarticus		Dark blue	Red	Unconfirmed
M. gouazoubira	Red	Dark blue	Dark blue	Red
S. scrofa	Dark blue	Dark blue	Dark blue	Dark blue
C. brachyurus			Dark blue	
C thous	Dark blue	Dark blue	Dark blue	Dark blue
P gymnocercus	Dark blue	Dark blue	Dark blue	Dark blue
P cancrivorus	Dark blue	Dark blue	Dark blue	Dark blue
N. nasua		Dark blue		Dark blue
L. longicaudis	Unconfirmed	Dark blue	Dark blue	Unconfirmed
C.chinga	Dark blue	Dark blue	Unconfirmed	Dark blue
G. cuja	Dark blue	Dark blue	Dark blue	Dark blue
P concolor		Dark blue		
O. geoffroyi	Dark blue	Dark blue	Dark blue	Dark blue
L. pardalis		Dark blue		
L. wiedii	Dark blue	Dark blue		
L. braccatus			Dark blue	
H.hydrochaeris	Dark blue	Dark blue	Dark blue	Dark blue
S. spinosus	Dark blue	Dark blue		
M. coypus	Dark blue	Dark blue	Dark blue	Dark blue
L. europaeus	Dark blue	Dark blue	Dark blue	Dark blue

Dark blue indicates presence of the species by department: red indicates historical presence but that the species is no longer found there (these data are not available for every species).

According to the IUCN Red List, seven species are Near Threatened; one Vulnerable; and one Endangered. Eight species are listed on Appendix 1 of CITES (Convention on International Trade in Endangered Species), meaning the trade is prohibited because the species is in danger of extinction. Six more are listed on CITES Appendix II, which prohibits trade because the species may become threatened unless trade is controlled. Table 17 shows the habitat of the species, whether it is native or exotic and the conservation status in the IUCN Red List and under Uruguayan legislation. The Law 9.481, from July 4 1935, bans the hunting of all mammals except the feral pig (*Suis scrofa*). A hunting license is needed for axis deer (*Axis axis*) and hare (*Lepus europaeus*) (MGAP, 2007).

To check
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We need to add English / Spanish names

Table 17: **Habitat, origin and status of large terrestrial mammals in Uruguay**

Species	**Habitat**	**Native / Exotic**	**Conservation Status**		
			IUCN Red List	CITES	Status in Uruguay
D. albiventris	F	N	LR/lc		ANRH
C. tatouay	F	N	LC	III	P
D. hybridus	P	N	NT		ARH
D. novemcinctus	P	N	LC		P
E sexcinctus	P	N	NT		P
M. tridactyla	F	N	LC	II	P
T. tetradactyla	F	N	LR/lc	II	P
A. axis	F / P	E	LR/lc		ARH
D. dama	F / P	E	LR/lc		ARH
B. dichotomus	W / P	N	Vu A4acde	I	P
O. bezoarticus	P	N	NT	I	P
M. gouazoubira	F	N	DD		P
S. scrofa	F / P	E	LR/lc		ANRH
P. tajacu	F	N	LR/lc	III	P
C. brachyurus	W / P	N	NT	II	P
C thous	F	N	LC	II ??	P
P gymnocercus	P	N	LC	II	P
P cancrivorus	F / P	N	LR/lc		P
N. nasua	F	N	LR/lc	III	P
L. longicaudis	A	N	DD	I	P
P. brasiliensis	A	N	En A3ce	I	P
C. chinga	F / P	N	LR/lc	II	P
G. cuja	F / P	N	LR/lc		P
P concolor	F / P	N	NT	I	P
O. geoffroyi	F	N	NT	I	P
L. pardalis	F	N	LC	I	P
L. wiedii	F	N	V ?	I	P
L. tigrinus	F	N	NT		
L. braccatus	W / P	N	---	II	P
H. hydrochaeris	W / P	N	LR/lc		P
S. spinosus	F	N	LR/lc	III	P
A .paca	F / P	N	LR/lc	III	P
M. coypus	W / P	N	LR/lc		P
L. europaeus	P	E	LR/lc		ARH

Key:

Habitat: F = forest; P = pasture; W = wetland; A = aquatic

Origin: N = native; E = exotic

Red List Categories: LR/lc = Lower risk – least concern; Vu = Vulnerable; En = Endangered; Lc = Least concern; NT = Near Threatened; DD = Data Deficient

CITES ("Convention on International Trade in Endangered Species"): - Appendix I: Trade prohibited (species threatened with extinction); Appendix II: Trade prohibited (species may become threatened if trade is not controlled); Appendix III: Species listed under request of a member country

Status in Uruguay: ARH = Allowed Regulated Hunting; ANRH = Allowed Non-Regulated Hunting; P = Protected

Distribution of mammals in the plantation landscape

The ecosystem with the highest diversity of large mammals is native forest, in particular riparian forest. These support gray brocket deer (*M. gouazoubira),* crab-eating fox *(Cerdocyon thous),* crab-eating raccoon *(Procyon cancrivorus),* coati *(Nasua nasua)*, lesser grisson *(Galictis cuja),* Geoffroy's cat (*Oncifelis geoffroyi),* ocelot *(Leopardus pardalis)* and margay (*Leopardus wiedii).* In the north, there are records of coendu (*Sphiggurus spinosus*) associated to "Serrano" forests.

Many species associated with wetland ecosystems are rare in Uruguay, such as the marsh deer (*Blastocerus dichotomus*), the maned wolf (*Chrysocyon brachyurus*) and the "pajonal cat" (*Lynchailurus pajeros*). Aquatic species include the neotropical otter (*Lutra longicaudis*), capybara (*Hydrochoerus hydrochaeris*) and coypu (*Myocastor coypus*).

Status of mammal species in campos

Around half the species in the region use campos some or all of the time, with five species being listed purely as grassland species, eight as inhabiting forest and grassland and a further five wetland and grassland. Four of these are exotic. Status of native campos species is examined in Table 18 below.

Table 18: **Status of campos species found in the landscape**

Species	English name	Red List Status
Pasture		
Dasypus novemcinctus	Nine-banded armadillo	Least concern
Euphractus sexcinctus	Six-banded armadillo	Near threatened
Pseudalopex gymnocercus	Pampas fox	Least concern
Ozotoceros bezoarticus	Pampas deer	Near threatened
Pasture and forest		
Procyon cancrivorus	Crab-eating racoon	Lower risk
C chingai		Lower risk
Galictis cuja	Lesser grison	Lower risk
Puma concolor	Puma	Near threatened
Agouti paca	Paca	Lower risk
Pasture and wetlands		
Blastocerus dichotomus	Marsh deer	Vulnerable
Lynchailurus braccatus	Pajonal cat	Not listed
Hydrochoerus hydrochaeris	Capybara	Lower risk
Myocastor coypus	Coypu	Lower risk

The most vulnerable campos species and thus most likely to be affected by plantations are the deer species and the puma.

The most vulnerable campos species, and therefore the most likely species to be affected by the plantation, are therefore the deer species and puma. The **six-banded armadillo** is listed as near threatened by CITES but is widely distributed throughout Uruguay. The **puma** has been recorded in Tacuarembó and in two other regions of the country: Artigas and Lavalleja. It is a rare species, due to hunting because of the threats it poses to cattle production. It is listed as Appendix I by the CITES. The puma is also wide-ranging and unlikely to be seriously affected by plantations; indeed they may provide safe cover.

There are only three Neotropical deer species in Uruguay: pampas deer (*Ozotoceros bezoarticus),* gray brocket deer (*Mazama goauzoubira)* and marsh deer (*Blastocerus dichotomus)* (Weber & González, 2003). No viable populations of this last species have been detected in the last 50 years. There is only a record of hunters in the department of Río Negro in 1990 (Pinder & Seal, 1994, González, 2004).

The **pampas deer** (*O. bezoarticus)*) was once found widely in the region but has since become locally extinct. It is the most emblematic herbivore of Uruguayan grasslands, but has suffered a dramatic decline probably linked to the habitat alteration, fragmentation and reduction of its natural habitat caused by agriculture and cattle production. This has occurred mainly since the 19th century. Only two pampas deer populations are known in Uruguay today: El Tapado (approximately 1000 individuals) in the department of Salto, and Los Ajos (with 400 individuals), in the department of Rocha. Both of them are listed by the IUCN as "species threatened with extinction". In Uruguay the species has been declared Natural Monument (decree 09/85).

The **marsh deer** (*B. dichotomus*) today occurs in southeastern Peru, Bolivia, Paraguay, Argentina, Uruguay and Brazil at the south of the Amazonian rain forest. Populations are located in the river basins of the main South American rivers to the south of the Amazon: the Río de la Plata basin, the Amazon River and the Río San Francisco River although the current status of the species in the last of these is unknown. The deer prefers floodable areas where the water depth is less than 60 cm, with low vegetable cover. In the State of Río Grande do Sul in Brazil, some individuals from a residual population used fields where rice and corn was planted. The species is threatened by habitat fragmentation (González et al 2001), and from diseases introduced by cattle (Duarte, 2001).

The **gray brocket deer** (*M. gouazoubira*) is a species of generalist habits, with low impact regarding hunting and environment modifications (Redford and Eisenberg, 1992), although it suffers a high hunting pressure in all the distribution range. It has been studied in Argentina (Weber and González 2003), Brazil (Duarte 1998), Bolivian and Paraguayan Chaco and Peru (Weber and González 2003), and in Uruguay (González 2004), although there is not enough information to assess its conservation status.

Using mammals as indicators

Large mammals are good indicators of biodiversity. The populations of many species of deer and carnivores have decreased due to the effects of habitat fragmentation and urbanization. As carnivores are at the top of the ecosystem, changes in the population of these species may reflect alterations in the previous levels of the trophic chain, e.g. an increase in the number of rodents. However, they are difficult to observe and often live at low densities.

Two non-invasive methods have been used in Uruguay. In order to assess the presence of the two species of fox in Uruguay – crab-eating fox (*Cerdocyon thous)* and pampas fox (*Pseudalopex gymnocercus*) – a molecular taxonomic system was designed using non-invasive sampling techniques. The method is based on the DNA extraction of stool. A fragment of mitochondrial DNA from a control region is then amplified and analyzed by PCR-RFLP.

Fecal DNA isolation

Deer species have been mapped by collecting tissue and stool samples in the following locations: Río Negro, Rivera, Rocha, Maldonado, Tacuarembó and Salto. It was determined that the samples belonged to the species *Mazama gouazoubira* (González et al 2004a,b) – see Figure 13. In addition, a Trail Master remote camera was placed in San Miguel-Rocha National Park and in Valle Edén-Tacuarembó. No photographs of the species were obtained in San Miguel. The presence of a female was registered in Valle Edén, and confirmed by molecular analysis.

Deer are candidate indicator species, particularly *Mazama gouazoubira,* which is likely to be present in native forests in the plantation landscape. Pampas deer would have been an excellent indicator in pastures, but its presence has not been recorded there for several decades. Carnivores, particularly foxes in the Canidae family and the neotropical river otter (*Lutra platensis*) in the Mustelidae family are excellent indicator species candidates. *L. platensis*, in particular, lives in clean waters and is very sensitive to environmental changes.

<u>Note</u>: we need the source for this map

Mazama gouazoubira

Ozotoceros bezoarticus

Figure 13: **Distribution of deer species located using non-invasive indicators**

Conclusions

The rarest campos mammal species – puma and deer – are relatively unlikely to be found on the lands being bought by Stora Enso, although would need careful attention if they were discovered. Many other important mammal species are likely to occur. Because many are confined to residual natural vegetation (particularly natural woodlands) the chief management need would be to maintain connectivity by not isolating natural habitat by plantations. This need increases for those species that use both *campos* and some other habitat, such as woodland or wetland.

Birds

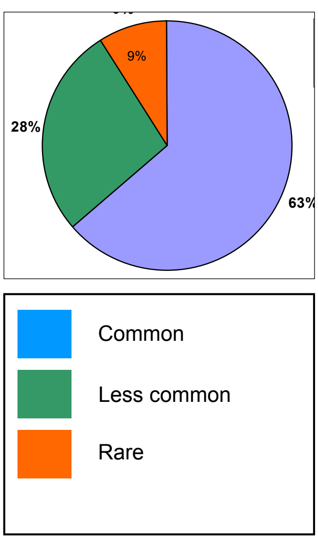
Uruguay has a relatively rich bird fauna that has on the whole been able to adapt to the changes brought about by management, although loss of habitat has made some species far less common. Today birds face fresh pressures as a result of intensification of agriculture and in particular an increase in pesticides, which are still largely uncontrolled.

Methodology

Data were drawn together on birds of the proposed plantation landscape, based on existing literature, collection data (particularly in the Museo de Historia Natural de Montevideo, and Facultad de Ciencias collections), previous surveys on behalf of Stora-Enso and data from the expert consultants.

Overview

A full list of bird species recorded from the area is given in appendix 2. The following section provides some key statistics.



Resident birds: a total of 267 bird species were registered in the study area (75 per cent of the non marine bird species of Uruguay). Of these, 194 (63 per cent) were common species, 54 (28 per cent) less common, and 13 (9 per cent) rare.

Migratory birds: 63 migratory birds have been recorded in the study area including 52 summer migrants and 11 winter visitors: 53 are considered to be common, 18 less common and 10 rare.

The main habitat preferences were concentrated in open landscapes ranging from campos to park-like grassland with scattered trees, Table 19 below summarises information on habitat preferences. If grassland (21 per cent) and park habitats (19 per cent) are amalgamated, it can be seen that more bird species prefer this type of ecosystem than any other.

Table 19: **Habitat preferences of birds in the proposed plantation landscape**

Habitat preferences	Number of species
Grasslands	55
Park-like grasslands	50
Water and shores	81
Woods	80
Associated with humans	2

Most birds are insectivorous and a breakdown is given in Table 20 below.

Table 20: **Trophic preferences of birds in the proposed plantation landscape**

Habitat preferences	Number of species
Insectivorous	129
Granivorous	42
Piscivorous	27
Small vertebrates	25
Herbivorous	13
Frugivorous	13
Invertebrates	12
Carrion	5
Nectar	3

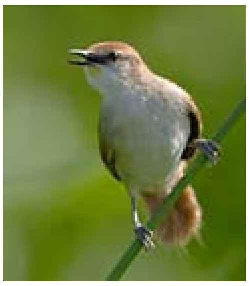
The major habitats for birds in the plantation landscape

Three particular landscape types are worthy of note:

The sierra of the south-eastern border of the landscape

This sierra is limited by the National highway number 7 and consists of an undulating landscape with a North/South orientation. The productivity of the land is poor and it is called *campos sucios* ("dirty lands") with prevailing *Eupatorium buniifolium*. The main bird species are the Turkey Vulture (*Cathartes aura*), the Lesser Yellow-headed Vulture (*C. burrovianus*) and the Black Vulture (*Coragyps atratus*), the Dusky-legged Guam (*Penelope obscura*) and the Red-legged Seriema (*Cariama cristata*), along with some Passeriformes.

Campos



Various grasslands dominate the region. The road network is important in the area. The main landscapes are mosaics, made up of small reservoirs, rice fields, plantations, forage cultivated areas and natural and artificial grasslands. The main bird species include the Greater Rhea (*Rhea americana*), Spotted Tinamou (*Nothura maculosa*), Red-winged Tinamou (*Rynchotus rufescens*), Southern Lapwing, Rufous Hornero (*Furnarius rufus*), Field Flicker (*Colaptes ampestris*), Picazuro Pigeon (*Columba picazuro*), Shiny Cowbird (*Molothrus bonariensis*), etc

High Rio Negro and Rio Tacuarembó fluvial plains

The plains are very important from the biodiversity perspective. They arise from a sedimentary system contributed by the two major rivers, including large gallery woods, wetlands, and some sand dunes. The main vegetation types are trees and shrubs. The principal bird species of note include the Rufescent Tiger-Heron (*tigrisoma lineatum*), Purple Gallinule (*Porphyrula martinica*), Blue-black Grassquit (*Volatinia jacarina*), and wood bird species like Diademed Tanager (*Stephanophorus diadematus*), etc.

The potential impacts of plantations on birds of the region

Approximately 40 per cent of the bird species registered in the study area relate in one way or another to grassland habitat and are thus potentially impacted by plantations.

One of the best known species dependent on grasslands is the Greater Rhea, which prefers open grasslands; rhea are omnivorous, preferring vegetables, seeds and fruits but are occasionally observed eating small vertebrates (amphibians, small birds or reptiles). Reduction of "natural" grasslands would have negative effects on this species, although by maintaining some open areas and natural corridors the effects could probably be minimized.

Other examples of open grassland species include the Red-winged and Spotted Tinamous. The Red-winged Tinamou prefers dense grassland areas, being more solitary (and has legal protection in Uruguay). The reproduction time in Uruguay extends between September and February and food of choice is insects. On the other hand, the Spotted Tinamou, prefers shorter grass, sometimes being seen in cultivated areas and roadsides. They also eat insects and seeds. Classical plantation approaches can certainly impact adversely on tinamous but impacts can be minimized through the implementation of a forest mosaic approach, i.e. by maintaining some open areas.

Most birds of prey rely on open territory to hunt and several falcons could be affected. The White-tailed Kite, which inhabits grasslands, cultivated areas, and also urban areas, eats small vertebrates or insects and needs open areas to hunt.

A number of campos bird species, including the greater rhea, will need special attention in management if damage is to be avoided.

The Long-winged Harrier is usually seen near water bodies, where they hunt for amphibians, small mammals, birds and eggs. The Cinereous Harrier is considered a "rare" species in Uruguay and their detection in planned plantation areas would necessitate some conservation plans. The Sharp-shinned Hawk is also considered as "less common" in Uruguay with an important link in the grassland ecology (Bildstein and Meyer 2000), having major impacts on small mammal populations. The Savannah Hawk is also is considered "less common" with distribution is in central/northern/eastern Uruguay. In all these cases, maintenance of open areas is important for survival.

Some important migratory shorebirds also pass through the area and rely on coastal lagoons and, of relevance here, inundated grasslands during their stay in Uruguay. The Golden Plover migrates from North America to Uruguay and Argentina and prefers inundated and open grasslands. It is a currently a "common" species in Uruguay and maintenance of these ecosystem types should help to maintain populations. The Tawny-throated Dotterel is considered "less common". Individuals of this species utilise open areas, feeding on insects and invertebrates. The Upland Sandpiper is also a summer visitor to Uruguay from North America and considered as "less common". This species faces some conservation problems principally from loss of habitats, urbanisation and changes in landscape structures (Houston and Bowen 2001). The Buff-breasted Sandpiper is also a summer visitor from northern Alaska and Canada and is considered as "almost threatened" in the Red List of the IUCN (IUCN 2006) and is also listed in the Appendix II of the Convention of Migrating Species. During their stay in Uruguay, they prefer coastal shores, lagoons, pools and inundated grasslands, feeding principally on insects and spiders.

The Short-eared Owl is considered as "less common" in Uruguay and being reliant on open grassland and cultivated areas. The Passeriformes considered as "less common", such as the Hudson's Canastero, the Black-and-white Monjita, the four species of Pipits, the Double-collared Seedeater, the Chestnut seedeater and the Lesser Red-breasted Meadowlark and the White-browed Blackbird, are all from open grasslands and need shorter or higher prairies for their biology.

Indicator species

In Uruguay knowledge of indicator species is low. Characteristic species of different environments could be considered as indicators, for example the Spotted Tinamou, the Pipit species or the Greater Rhea, but we think that indicators will probably have to be defined in every case, after the definition of the areas.

Conclusions

Almost half the birds of the region (40 per cent) are linked to grassland and therefore are potentially impacted by plantations. Managing for biodiversity, in particular by adopting a mosaic approach with open areas, can reduce many of these effects. Conservation of wetlands and conservation and restoration of native woodlands, particularly riparian woodlands, could provide some net benefits.

Reptiles and amphibians

Based on current knowledge, there are 48 amphibian species and 67 species of reptiles in Uruguay (Achaval 2007; Maneyro and Carreira 2006; Maneyro and Beheregaray, in press; Carreira and Lombardo, in press). The study area includes at least three of the five main taxonomic groups of amphibians (Maneyro et al 1995; Maneyro and Beheregaray, in press), but reptiles have generally been less systematically studied, with records indicative of casual encounters and clearly associated with main national roads or specific collecting activities.

Continental reptiles and amphibians tend to have a low ability to move between sites, which make them particularly sensitive to environmental changes at a local scale (habitat impoverishment and fragmentation, capture of specimens, etc). This fragility is further increased by global scale factors (global warming, thinning of the ozone layer, etc.). Together, these factors make the taxa especially vulnerable. This is reflected in a particularly dramatic way in endemic species, where reduction of a single population can jeopardize the survival of the species.

The survey was based on the existing bibliography on the reptiles and amphibians of Uruguay, adapting it to the scale appropriate for the study area, drawing particularly on Carreira et al (2005) for reptiles and Nuñez et al (2004) for amphibians. Knowledge about distribution of amphibians and reptiles in Uruguay is based mainly on records provided by the official national collections: the Museum of Natural History and Anthropology (MUNHINA), of the Ministry of Education and Culture and the Vertebrate Zoology Collection (ZVC) of the School of Sciences, University of the Republic. This has inevitable limitations: sampling is not systematic, the ability to detect species is not constant and in some cases we do not know whether current distribution patterns have changed compared to historical distribution. Lists therefore contain both confirmed species and the possible presence of species based on habitat and expected distribution.

The plantation landscape contains three quarters of the reptiles in Uruguay and two thirds of the amphibians.

The plantation landscape contains most of the amphibians and reptiles known in Uruguay: 50 reptile species and 33 amphibian species: i.e. three quarters of reptiles and two thirds of amphibians. A thorough review of all species is beyond our scope, but general comments follow, which help outline the importance of the area and particular species of note. A full list is in Appendix 3.

Amphibians of the study area

- ✓ *Chthonerpeton indistinctum* is the only legless amphibian species recorded in Uruguay, and all the existing data come from coastal areas, except for one specimen recorded in the department of Durazno.

- ✓ Among anurans, three species of particular interest belong to the genus *Chaunus*. *C. dorbignyi* and *C. fernandezae* are widely distributed but hybridization makes it difficult to map them at species level. *C. achavali* was recently described and has only been recorded in Uruguay and southern Rio Grande do Sul, Brazil. The type locality (Pueblo Valentines) is within the boundaries of the study area.

- ✓ The genus *Melanophryniscus* is represented by two species: *M. atroluteus* and *M. sanmartini*, although other species of this genus may be expected. *M. sanmartini* is an endemic species of Uruguay living in hilly areas and faces conservation problems at population level.

- ✓ The family Hylidae is the most numerous in Uruguay, including 16 species. Eleven of them may be found in the study area. References to *Dendropsophus minutus*, *Scinax aromothyella* and *Scinax fuscovarius* were first made in Uruguay in locations near the plantation landscape. The type location of *Scinax uruguays* is also within the area of interest. *Phyllomedusa iheringii* is the only anuran species in Uruguay that builds a nest, using trees next to lotic water bodies.

- ✓ The Leptodactylidae family is represented by four of the seven species in Uruguay, all in *Leptodactylus*. They have complex reproductive behaviour, such as nest building and parental care, implying the presence of environments such as floodable grasslands.

- ✓ *Elachistocleis bicolor*, the only Uruguayan microhylid species, is widely distributed, but nonetheless its population dynamics may be affected by forestry, as its diet is based on ants (Berazategui et al in press).

- ✓ Six species of the Leiuperid family, belonging to three genera, and two species of the Cycloramphidae family occur. The Leiuperidae group includes four species of the genus *Physalaemus* (all species from this genus require semi-permanent aquatic habitats to build their foam nests). Two species, *P. henselii* and *P. riograndensis,* are strongly associated with hilly environments. *Pleurodema bibrioni* is little known and possibly endemic in Uruguay. *L. macroglossa* is monotypic (the only species in its genus) and found in hilly habitats throughout whole country.

Reptiles in the study area

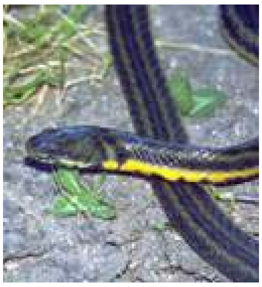
- ✓ Four of the five species of continental turtles recorded in Uruguay are present in the landscape. The most frequent are *Trachemys dorbigni*, *Hydromedusa tectifera* and *Phrynops hilarii*. These species live in lowland environments, near watercourses and lagoons. Although there are no records in the study zone, the fifth species *Phrynops williamsi* may also be present: it is a little known, with records in Salto, Artigas, Rivera and Cerro Largo.

- ✓ It is possible that the only crocodilian species in the country, *Caiman latirostris* (*yacaré*; broad-snouted caiman) is in the plantation landscape. There are records in the Río Tacuarembó, as well as observations made by staff of the rural establishment "Los Argentinos".

- ✓ There are ten lizard species recorded in the area. It is worth noting the presence of *Liolaemus wiegmannii* near Zapicán (Lavalleja) as this is outside its expected distribution pattern. Other species are *Tupinambis merianae*, *Cercosaura schreibersii*, *Mabuya dorsivittata*, and *Teius oculatus. Cnemidophorus lacertoides* and *Homonota uruguayensis* (the only autochthonous Gekkonidaeare), which are more restricted to hilly areas. The same is true for *Stenocercus azureus,* a very scarce and little known species, listed as vulnerable in Uruguay. There are also two of the three species of legless lizards recorded (*Ophiodes* aff. *striatus* and *Ophiodes vertebralis*).

- ✓ Although the presence of *Anisolepsis undulatus* has not been confirmed in the study area, it is likely. The Uruguayan territory includes most of its known distribution range and it is listed as vulnerable at global level by IUCN (Hilton-Taylor 2006). Its ecology is little known and it uses low vegetation in rocky hills. Snakes make up 60 per cent of the reptiles expected or confirmed in the study area. Nineteen of these 30 species are recorded in national collections.

According to Morales Fagundes and Carreira (2001), *Leptotyphlops munoai*, *Boiruna maculata*, *Liophis almadensis*, *Liophis flavifrenatus*, *Phalotris lemniscatus*, *Philodryas olfersii olfersii* and *Pseudablabes agassizii* are classified as having conservation problems within the country. Within this group of reptiles, there are four species considered dangerous for humans. Only *Bothrops alternatus* (crucera) and *Bothrops pubescens* (yara or yarará) have caused accidents in recent decades in Uruguay.



✓ Among widely distributed species, *Liophis anomalus*, *L. poecilogyrus sublineatus,* and *Philodryas patagoniensis* are the most numerous. The first two consume significant numbers of amphibians. *Leptotyphlops munoai* is found in hilly environments. It is the smallest ophid in the country and feeds only on ants and termites.

Most of the rare or endemic species are found in the basaltic and crystalline-metamorphic hills in the region.

Important habitats

The area that includes the basaltic and crystalline-metamorphic hills is the most diverse within the study area. Most of the species that are rare, endemic and/or face conservations problems are found there. For many taxa, this environment is the southern limit of their distribution (i.e. some of the amphibian species of the so-called "fauna from Rio Grande").

Indicator species

A number of initial suggestions for indicator species are included. *Helicops infrataeniatus*, a snake, seems to be sensitive to environmental conditions and might be a suitable indicator (although there have as yet been no detailed studies and the suggestion is based on personal observation). Some lizard species could also be considered. Species of the genus *Melanophryniscus* are suggested in the amphibian group: their sensitivity to habitat fragmentation and loss has been documented. In addition the Hylidae family (e.g. *Phyllomedusa iheringii*), might be suitable due to its rather specialized hilly, lotic habitat.

Conservation implications and monitoring

A number of conservation requirements have been identified.

Research: clearly more research is required, because at present lack of knowledge means that it is quite difficult even to define a baseline and many species doubtless remain unrecorded or with their distribution, status and needs only very poorly understood. Permanent surveys and monitoring of key areas would both be beneficial. Such control areas have a double purpose. They allow the follow-up of the impact of any environmental changes on populations at ecosystem level, and generate basic information on the natural history of the species (diet, reproductive dynamics, etc.)

Control of agrochemicals: some taxa use ant nests to deposit and develop their eggs. Although there are bibliographical references on these aspects (Vaz-Ferreira et al 1970; 1973), the impact of the use of biocides to control ants on reptile populations is unknown. As stated above, there are amphibian species (i.e. *Elachistocleis bicolor)* and reptiles *(i.e. Leptotyphlops munoai)* that feed on ants and termites respectively. The impact that some insecticides (i.e. carbaryl and malathion) and herbicides (i.e. glyphosate) have on aquatic communities is known (Relyea 2005a; b). The need for responsible management of these substances in the Uruguayan forestry model has been pointed out by Geary (2001). Experimental research studies on the use of biocides and the impact they could have on the populations of amphibians and reptiles would be a useful element of any monitoring system.

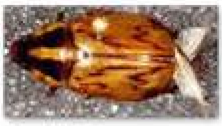
Insects

As with other aspects of biodiversity, knowledge about insects of the region is limited. The experts therefore did not attempt to compile information on everything – an impossible task with such a large and diverse group – but instead focused on those species that were likely to provide the most useful data for monitoring change. This section therefore starts with a discussion of the use of insects in monitoring and then goes on to discuss make some specific proposals for the monitoring system.

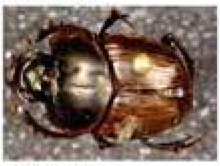
Insects as indicators

Even though the commonest choice of indicator species are usually plants (Pharo et al 1999) and some groups of vertebrates (Garson et al 2002), it is now no longer unusual to use invertebrates to assess biodiversity (Hull et al 1998; Palmer 1999; Sluys 1999). In fact, studies using insects as indicator taxons, such as the group Cicindelidae - Coleoptera (Pearson and Cassola 1992), butterflies (Ricketts et al 2002) or other groups of invertebrates are increasingly common.

Coleoptera: beetles



Cyclocephala mutata



Onthophagus gazella

Taxonomically, Coleoptera account for over 40 per cent of the diversity described for Hexapoda at the global level with about 350,000 species described to date. Within that Order of insects, several features support the use of dung beetles (Scarabaeoidea) as a group to be considered when carrying out biodiversity studies in the short (rapid ecological assessment) and long term (monitoring):

- ✓ They are easy to capture and sampling protocols easily standardized
- ✓ They are a species-rich group that plays a significant role in the functioning of ecosystems by recycling nutrients and seeds. Scarabaeidae are sensitive to resources availability and changes in the vegetation (Fávila and Halffter 1997)
- ✓ They have a manageable taxonomy, worldwide distribution and the different aspects of their biology are well known
- ✓ They have a dramatic response to the modification of natural environments by human action (Halffter and Favila 1993; Hammond 1995; Favila and Halffter 1997)

Dung beetles have been used as possible indicator groups of biodiversity changes at a specific level and at landscape level, due to anthropogenic changes (Halffter and Arellano 2002). Most of the studies, however, aim to determine what happens at a specific level when vegetation is destroyed or drastically reduced in extension (Klein 1989; Shure and Phillip 1991; Majer and Beeston 1996; Halffter 1998). The different activities of beetles may be related to soil structure and supply of resources, in particular the amount of food and the variety of types of dung, which plays a major role in the maintenance of dung beetle populations (Astrid et al 2003; Escobar 2000; Morelli et al 2002)

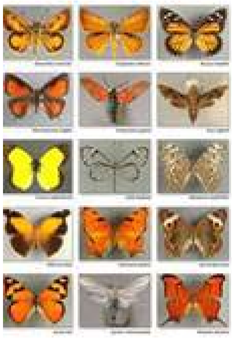
Aquatic insects

The disproportionate loss of aquatic habitats has raised interest in the use of Coleoptera as indicators of a range of freshwater habitats. All freshwater bodies are good habitats for aquatic Coleoptera. From an ecological point of view beetles, and particularly their larva stage, are particularly useful indicators as they are so diverse, taking part in multiple food chains where they act as predators, detritivors, herbivores or periphyton eaters. Finally, these insects may act as allochthonous organic matter transformers and integrators (i.e. leaves, seeds, branches, fallen trees) (Araya 2000).

Aquatic Coleoptera are therefore good candidates to be used as biodiversity indicators in aquatic environments. Due to the diversity in number of species, size variation and ecological conditions, they are an ideal group for environmental impact studies, conservation proposals and biodiversity studies in a broad sense and can help to detect spatial and temporal changes (Bournaud et al 1992; Richoux 1994; Millán et al 2001a and b 2002; Pearson 1994; Halffter et al 2001). Within benthic macroinvertebrates, Elmidae are particularly sensitive to pollution (Figueroa et al 2003).

They are a simple and low cost tool to identify priority conservation areas, as the diversity, rarity and threaten patterns of this group are apparently strongly linked to the patterns in other organisms usually used to select protected areas, such as vertebrates or plants (Ribera et al 1993; Abellán et al 2004)

Lepidoptera: butterflies and moths



Lepidoptera are indicators of the conservation status, degree of endemism and biogeographic affinity of an area, as there is a significant correlation of larva and imago due to their herbivore habits and nectar requirements respectively, and their high sensitivity to environmental changes and variations in native vegetation. They also fulfil the characteristics of an indicator group and their use in monitoring and environmental assessments is been increasingly accepted. It is possible to identify common, migrating, key, rare and endemic species. A decrease in diversity, together with a significant reduction or increase of some species populations, indicates an environment alteration. Nymphalidae is the most studied family as indicator of environmental quality, mainly because of the important data already existing on that family.

Survey of existing information for the plantation landscape

The research team used bibliographic information to identify the list of species of Coleoptera (beetles) and Lepidoptera (butterflies and moths) in the area studied, which due to limitations of information was confined to Tacuarembó, Durazno and Paysandú. Data were drawn from a range of published species' lists and from collections in three academic bodies in Montevideo.

Coleoptera

According to sources consulted, there are records in Uruguay of 63 families of Coleoptera, including 607 genres and 1,615 species. Of these, 16 families and 81 genera have been found in the area studied. The Cerambycidae family has the most species, with 34 species recorded in the area. Then follow the families Tenebrionidae (9), Carabidae (8) and Rutelidae (5), although with significantly lower diversity and the remaining families each have less than five species recorded.

Based on the concepts explained above and in section 2, species from the families Scarabaeidae, Aphodiidae, Trogidae and Geotrupidae are suggested as possible indicator groups for monitoring terrestrial ecosystems and species of aquatic Coleoptera for monitoring watercourses.

Lepidoptera

According to the sources consulted, there are records in Uruguay of 43 families of Lepidoptera, including 737 genera and 1,241 species, of which there are 31 families and 348 genera in the area studied.

The Noctuidae family is the one with most species, with a total of 61 species recorded in the area, followed by the families Nymphalidae (45), Hesperidae (41), Pieridae (24), and Sphingidae (20). The rest of the families have less than 20 records: Geometridae (18), Arctiidaae (18), Riodinidae (15), Crambidae (15), Lycaenidae (14), Saturniidae (12), Ctenuchiidae (11), Pyralidae (10); including 10 families with less than 10 record, and eight with one record.

Butterflies have some advantages as indicators, being relatively easy to identify and also possible to identify in many cases from photographs. From the perspective of work in Uruguay, some are also indicators of former agricultural land, thus identifying site where biodiversity loss is not likely to be a problem. Some possible lepidopteron indicators are outlined in Table 21 below.

Table 21: **Some possible Lepidopteron indicators**

Family	Species	Observations
Nmphalidae	*Biblis hyperia* *Dryadula phaetusa* *Phoebis philea* *Anteos menippe* *Adelpha sp.*	Understory forest, open areas spp.
	Euptychia sp. *Ithomia sp.* *Lycorea sp.* *Anaea sp.* *Agrius sp.* *Prepona sp.* *Ccaligo sp.* *Eryphanes sp.* *Opsiphanes invirae*	Primary forest
	Heliconius sp. *Hamadryas sp* *Ithomia sp.*	Fragmented secondary forest
	Dryas Julia *Aphrissa statira* *Dione juno* *Dryadula phaetusa*	Indicators of cattle production area
	Anartia jatrophae	Very degraded areas
	Junonia evarete	Very degraded area (grassland)
Noctuidae	*Thysania agrippina*	Primary forest (Threatened for Rio Grande)
	Thysania zenobia	Secondary forest
Papilionidae	*Pterourus hellanichus*	Rare species (red list)
Nymphalidae	*Morpho catenarius*	Forest of *Coronilla emerus*

The insects of the plantation landscape are seriously under-surveyed…

Conclusions and recommendations

According to the bibliographic survey and the study of specimens collected more than 40 years ago, the area studied has a record of only 28 per cent of the Lepidoptera species and 5 per cent of the Coleoptera species found in Uruguay, suggesting that there is currently serious under-reporting. The surveys were made in one or two locations in each of the three departments considered and in most cases during a single season. It would therefore be essential to carry out an updated survey of the Coleoptera and Lepidoptera orders in the area to use them as bioindicators (see discussion on page ##).

As the Coleoptera order is so diverse, it is recommended to focus on the study of soil and aquatic species. Soil Coleoptera, predators and decomposers, are represented mainly in the families Carabidae, Staphylinidae and Scarabidaeidae, among others. These functional groups are indicators of the diversity of other groups, as well as physical-chemical changes in the soil and the functioning of the terrestrial ecosystems. On the other hand, aquatic Coleoptera are important describers of spatial, temporal and physical-chemical changes produced in fluvial systems (mainly Elmidae family). They are indicators of the richness of other groups and allow the identification of priority conservation areas.

Socio-economic context

A large project will impact on the economy in more ways than just employing people; knock of effects could relate to secondary employment, overall infrastructure and concerns about social change.

The plantation project will be a major economic force in the region, which like much of rural Uruguay is currently rather under-developed, with high levels of poverty. The primary concern for many local communities is about the extent to which the project may be able to offer jobs and money, how secure employment might be and who will get the jobs. A large project will impact on the economy in more ways than just employing people; knock of effects could relate to secondary employment (contractors but also restaurants, hotels, shops and do on), overall infrastructure (maybe better roads or maybe roads that are just more heavily used) and the concerns about social change brought about by an influx of new people. To understand what may happen, it is important to know where we start. The following section of the report therefore analyses the current socio-economic situation in the region in and near where Stora Enso is buying plantations, both to help understand what will happen and to help set a baseline for future monitoring.

The main aim is to analyze and characterize the territories of Durazno, Tacuarembó, the east of Paysandú and the east of Río Negro, from a social and economic point of view. The intention is to obtain a first assessment regarding the main strengths and weaknesses of the area from the perspective of the social and economic situation. Two main methods have been used:

- ✓ Literature survey of existing research on forestry issues relevant to the selected provinces
- ✓ Gathering and analysis of secondary information sources such as: population and housing census, agricultural and livestock census, home surveys, reports from international organizations, maps and legislation

The following section starts by analyzing the general characteristics of the area of study in relation to the rest of the country and then looks in more detail at the social and demographic characteristics of the different localities.

Social and demographic information

Uruguay is an increasingly urbanised population; Montevideo contains 41 per cent of the population while the rest of the country (99.7 per cent of the total area) contains 59 per cent of the population and less than 45 per cent of the GDP. The four provinces under consideration represent 29 per cent of the country, and only 10 per cent of the population (316,581 people), being some of the provinces with relatively low population density (except for Paysandú).

The general conditions in the country are mirrored within the micro-region under consideration, with 88 per cent of the population living in the city (280,174 people) even in an area that is considered to be primarily rural. Paysandú contains most of the region's population (36 per cent), followed by Tacuarembó (29 per cent), Durazno (19 per cent) and Río Negro (17 per cent). From a demographic perspective, 28 per cent of the population is under 14, 61 per cent from 15 to 64 and the remaining 12 per cent is over 65, the percentage of children being considerably higher than for the country as a whole. Gender ratio is 50:50. Within Uruguay, 174,393 people live in shanty towns, including 1,252 homes in the micro-region representing three per cent of the population and one per cent of the homes. Tacuarembó has no shanty towns, Paysandú has three per cent of the population in shanty towns and Durazno and Río Negro both have two per cent. . With respect to agricultural holdings, 57 per cent of the producers live on the holding and 43 per cent away from it.

Human Development Index

Since the 1990s, Uruguay has become part of the group of countries with greater rates of development in the region. Up to 2001, Uruguay was placed second among the countries of Latin American and the Caribbean in term of Human Development Index, (a composite index that covers: income, education and health) although it has since dropped to sixth place..

To check: Is the HDI worked out regionally as well?

In general terms, the Human Development Index in the four provinces means that they are classified as having a high human development (over 0.8), having evolved positively each year from 1991-2002.

Conditions for the rural population

To check: is this the 2000 or 2004 census? Not clear

Although the land is almost completely dominated by crops and pasture, this sector employs only a tenth of the population and many of these are family members who are not paid in a formal sense. The total rural area of the plantation landscape is 4,857,560 hectares which represents 99 per cent of the whole area. A total of 9,454 businesses were registered in the 2004 census and the agricultural population was estimated at 33,053 people (10 per cent of the total population registered in the 2004 Census), 88 per cent of whom are of working age. Table 22, from the Agricultural and Livestock Census by the Ministry of Cattle Agriculture and Fisheries in 2000, summarises information.

Although the land is dominated by crops and pasture, employment in the sector only affects a tenth of the population.

Table 22: **Basic agricultural and livestock characteristics**

Concept	Tacua-rembó	Durazno	Río Negro	Paysandú	Subtotal
Total amount of operations	3,327	2,364	1,361	2,402	9,454
Total rural surface (hectares)	1,472,806	1,093,060	947,055	1,344,639	4,857,560
Agricultural population	10,796	6,618	5,971	9,668	33,053
Total population of the Province (2004 census)	90,489	58,859	53,989	113,244	316,581
Working population	9,314	6,499	5,326	7,855	28,994
Hectares per farm unit	443	462	696	560	540
Residents per farm unit	3,24	2,80	4,39	4,02	3,61
Hectares per person	136	165	159	139	150
Workers per farm unit	2.80	2.75	3.91	3.27	3.18
Hectares per worker	158	168	178	171	169

Agricultural holdings tend to be reasonably large. The average number of hectares per holding of the region is 540 hectares, even higher in Río Negro and Paysandú, and in all cases higher than the average for the rest of the country.

Labour

With respect to the permanent labour force, it should be noted that 55 per cent of the workers are not paid in a formal sense (55 per cent of these are the producer or a partner themselves, 41 per cent a producer's relative and 4 per cent others) and the remaining 45 per cent are paid workers (of which we can distinguish 5 per cent professionals/technicians, 16 per cent administrators/foremen and 9 per cent machine or tractor operators with most of the rest classified as manual workers or ranch hands). This breakdown appears to be similar throughout the landscape.

Land tenure

Regarding the land tenure regime, in the micro-region 60 per cent are owners (accounting for 54 per cent of the land surface), 15 per cent tenants, 9 per cent owners / tenants and 10 per cent of the holdings operate under some other tenure system. Tables 23 and 24 below summarise the land tenure system in the region.

Table 23: **Number of holdings according to land tenure regime**

Tenure	Tacuarembó	Durazno	Río Negro	Paysandú
TOTAL	3,327	2,364	1,361	1,911
Owners	2,170	1,355	731	1,097
Tenants	364	360	300	289
Sharecroppers	14	4	23	17
Occupants	212	132	26	57
Owners /Tenants	236	264	103	193
Owners /Sharecroppers	3	1	16	30
Tenants /Sharecroppers			21	28
Other means	328	248	141	200

Table 24: **Surface area of holdings according to land tenure regime**

Tenure	Tacuarembó	Durazno	Río Negro	Paysandú
TOTAL	1,472,806	1,093,060	947,055	1,334,352
Owners	878,066	566,486	475,439	705,157
Tenants	149,718	127,109	82,513	154,325
Sharecroppers	2,377	392	14,883	5,964
Occupants	16,480	10,753	2,860	4,035
Owners /Tenants	200,856	243,177	142,306	228,092
Owners /Sharecroppers	86	62	8,859	51,140
Tenants /Sharecroppers			17,095	14,489
Other means	225,223	145,081	203,100	171,150

90 per cent of the land surface in the plantation landscape is owned by Uruguayans and used for agriculture.

The large majority of the operations (82 per cent) are single person businesses, with eight per cent joint venture and nine per cent legal partnerships. Regarding the nationality of producers, 96 per cent of agricultural businesses belong to citizens of Uruguay, representing 90 per cent of the land area and four per cent are foreigners including mainly Argentineans and Brazilians along with a few other nationalities. Around four per cent of the land area is currently in the hands of these “other nationalities”.

Education levels within the agricultural community

If the rate of primary and secondary school attendance is analyzed, rate is around 100 per cent for primary schooling in Durazno and Tacuarembó and 99 per cent in Paysandú and Río Negro. This is retained for the latter for secondary schooling, but drops considerably in other provinces: 86 per cent in Durazno, 84 per cent in Paysandú and 91 per cent in Tacuarembó. Education level varies widely amongst those involved in agriculture. Only three per cent have had no education but 17 per cent more did not complete primary schooling; at the other end of the scale 16 per cent of people have had a university education (12 per cent completing). 40 per cent of land is managed by people with a university education, suggesting that larger land owners tend to benefit from a better education – see Table 25.

Table 25: **Education levels within the agricultural community**

Educational level	Tacuarembó	Durazno	Río Negro	Paysandú
TOTAL	100.0	100.0	100.0	100.0
None	4.5	2.5	1.2	2.6
Primary completed	32.4	34.4	24.0	29.2
Primary not completed	24.1	13.1	11.1	15.7
Secondary completed	10.0	16.7	17.7	14.5
Secondary not completed	8.4	9.3	11.2	11.2
Technical completed	4.5	5.1	9.7	7.2
Technical not completed	1.3	1.4	1.9	1.8
University completed	9.1	11.5	16.9	12.0
University not completed	3.3	3.6	4.4	3.6
Other	1.0	1.1	0.7	0.6

Jobs and income level

According to the *Encuesta Nacional de Hogares Ampliada* [Extended National Domestic Survey], workrate in October 2006 is 60.6 per cent, although information is not available at provincial level. In rural areas this rate has remained stable overall, but has increased slightly in places with 5,000 or more inhabitants and declined in smaller places areas according to INE [National Institute of Statistics]. The trend for people to gravitate towards urban areas is continuing. Lack of provincial data is addressed to some extent by a survey carried out in the regions: however this used a small urban based sample and must be treated with caution. From this, it appears that employment rate for people over 14 exceeds 50 per cent in every case. Unemployment rate is below the national average. However, in all four provinces wage levels are also slightly below the annual average of $5.383.

The role of agriculture in economic activity

The contribution of agriculture and livestock to the economy has declined in the region in ecent years.

The provinces under consideration remained relatively stable during the period of economic downturn as compared to some other parts of the country, but in general the agriculture and livestock contribution to the economy has decreased over the last few years although it now shows some signs of recovery. Considering the country as a whole, in 2003, the primary sector represented 13.58 per cent, the secondary sector 28.32 per cent and the tertiary sector 58.1 per cent of the economic activity. The role of the primary sector increases slightly in rural provinces, but remains less than the tertiary sector even here, the latter reaching almost 50 per cent in all of the four provinces.

Land use

As regards land exploitation measured through the the total soil area exploited, we gather that in the micro-region, 74 per cent of the land is used as pasture, with other significant uses being six per cent of the land in plantations and six per cent in planted grassland. Table 26 below outlines more precisely the breakdown.

Table 26: **Breakdown of land use in hectares**

Land use	Tacuarembó	Durazno	Río Negro	Paysandú
TOTAL	1,472,806	1,093,060	947,055	1,344,639
Natural woods	74,650	12,609	33,807	54,073
Artificial woods	94,553	38,449	70,523	91,448
Citrus fruits	94		321	8.960
Other fruit trees	7	3	88	296
Vineyards	54	99	2	181
Orchard crops	1,882	76	498	453
Industrial and cereal crops	17,978	5,352	79,868	56,069
Annual fodder crops	13,474	15,603	42,192	35,406
Ploughed soil up to 6/30/00.	1,460	3,292	12,522	16,024
Stubble soil	3,267	2,665	14,566	13,149
Artificial prairies	41,118	46,174	110,367	79,085
Natural fields seeded under shelter	17,082	74,274	11,219	9,842
Fertilized natural fields	6,376	5,066	11,075	10,191
Natural fields	1,186,493	884,061	552,242	957,971
Non productive land	14,318	5,337	7,765	11,491

Table 27: **Breakdown of land use as a percentage**

Land use	Tacuarembó	Durazno	Río Negro	Paysandú
TOTAL	100.0	100.0	100.0	100.0
Natural woods	5.1	1.2	3.6	4.0
Artificial woods	6.4	3.5	7.4	6.8
Citrus fruits	0.0		0.0	0.7
Other fruit trees	0.0	0.0	0.0	0.0
Vineyards	0.0	0.0	0.0	0.0
Orchard crops	0.1	0.0	0.1	0.0
Industrial and cereal crops	1.2	0.5	8.4	4.2
Annual fodder crops	0.9	1.4	4.5	2.6
Ploughed soil up to 6/30/00.	0.1	0.3	1.3	1.2
Stubble soil	0.2	0.2	1.5	1.0
Artificial prairies	2.8	4.2	11.7	5.9
Natural fields seeded under shelter	1.2	6.8	1.2	0.7
Fertilized natural fields	0.4	0.5	1.2	0.8
Natural fields	80.6	80.9	58.3	71.2
Non productive land	1.0	0.5	0.8	0.9

As Figure 14 shows below, the dominant economic activity remains cattle farming

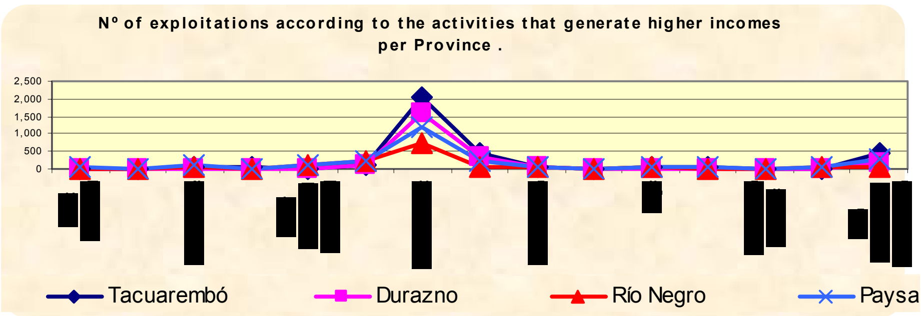


Figure 14: Key economic activities

Existing plantations

Taking the micro-region as a whole, six per cent is already plantation: Durazno has only four per cent while Río Negro and Paysandú already have seven per cent of the area under plantations. Most plantations (82 per cent) are established within the framework of the *Law for Promoting Forestry* (see Table 28). More than 98 per cent of plantations are in plots covering over 100 ha, and 83 per cent over 500 ha.

Table 28: **Relationship of plantations with the Law Promoting Forestry**

Size of exploitation	Total		Total micro-region Within the Law for Promoting Forestry		Outside the Law for Promoting Forestry	
	Ha	(%)	Ha	(%)	Ha	(%)
TOTAL	294,906	100.0	242,927	82%	51,979	18%
Less than 3	2,393	1%	1	0%	2,392	5%
From 3-0	5,732	2%	37	0%	5,695	11%
From 11-20	3,953	1%	210	0%	3,743	7%
From 21-50	7,064	2%	902	0%	6,162	12%
From 51-100	6,700	2%	2,640	1%	4,060	8%
From 101-500	48,816	17%	38,289	16%	10,527	20%
Over 500	220,248	75%	200,848	83%	19,400	37%

To check:
Is this correct relating to forest support?

There was a peak of planting in the mid to late 1990s, followed by a rapid falling off due to changes in the general economic situation and the specific support for forestry, as Figure 15 below outlines:

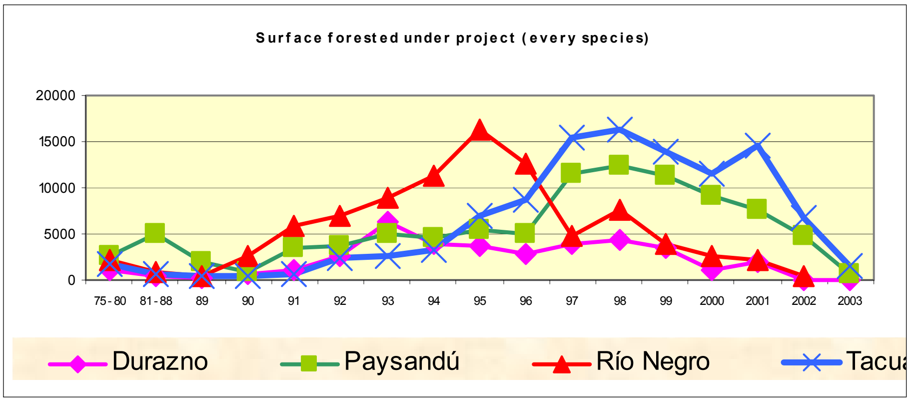


Figure 15: **Rate of forest establishment per Department**

Roads and other infrastructure

Around 29 per cent of agricultural and livestock holdings have access by a permanent road, 46 per cent use improved roads and 26 per cent earth roads. Tacuarembó and Durazno have comparatively more earth road access (35 per cent and 31 per cent). Around 43 per cent of holdings have a telephone, 61 per cent electricity, 14 per cent an administrator, 30 per cent technical assistance and 40 per cent maintain management records.

…although agriculture and livestock tend to generate the highest incomes, the four provinces also rely on forestry, fruit growing, horticulture and dairy production.

Summary

In summary, although agriculture and livestock tend to generate the highest incomes, the rural parts of the four provinces also rely on forestry, fruit growing, horticulture and dairy production. In Durazno and Tacuarembó, agricultural and livestock activity is still the most important primary industry within the provincial gross added value, with cattle highest, followed by agriculture. Gradually, other activities such as poultry, beekeeping, viticulture and more recently forestry are starting to have a greater effect. In Río Negro is the major contributor to the gross value of the agricultural and livestock production in the province, representing 23 per cent of the fertilized area in Uruguay, and the situation is similar in Paysandú.

Social and demographic characteristics of the four provinces

In addition to the general survey, more details were compiled for the four provinces under consideration, both to supply background to help planning the project and to provide a baseline against which monitoring and assessment can take place. The following areas were considered:

- ✓ **Durazno**: every locality
- ✓ **Tacuarembó**: every locality
- ✓ **East of Paysandú**: Piedra Sola, Arbolito, Tiatucura, Morató, Merinos, Piñera, Guichón
- ✓ **East of Río Negro**: Sarandí de Navarro, Rolón, Grecco

Durazno

From the 15 localities registered by the Census (excepting the capital city), only one has a population greater than 2,000 inhabitants (Sarandí del Yí and el Carmen); six more have a population of 1,000-2,000 (La Paloma, Santa Bernardita, Blanquillo, Cerro Chato, Carlos Reyles and Centenario). For the rest, San Jorge has a population slightly greater than 500, and the remainder are below 250 (Baygorria, Aguas Buenas and Ombúes de Oribe), or below 100 (Feliciano, Rossell y Rius and Pueblo Álvarez).

Regarding population distribution by age, the highest proportion of elderly people are found in Rossell y Rius and Pueblo Álvarez with 25 per cent of inhabitants over 65 years old. Proportions of elderly people of 10 per cent or more are found in Sarandí del Yí, Carmen, La Paloma, Santa Bernardina, Blanquillo, Cerro Chato, Carlos Reyles and Centenario. In every case except for Rossell y Rius children make up more than 20 per cent of the population. Both these statistics have implications for availability of labour. In nine places in the province less than 60 per cent of the population is from 15 to 64 year olds, although it is higher in Durazno, Santa Bernardina, Blanquillo, Centenario, San Jorge, Rossell y Rius and Baygorria, where it reaches 76 per cent. Around 98 per cent of the population lives in private houses and two per cent in collective houses; some 17 per cent of houses are currently empty although this average rises considerably higher in economically depressed areas such as Baygorria and Feliciano.

Tacuarembó

Tacuarembó has more towns and villages; 25 in addition to its capital city. Paso de los Toros is a city of over 10,000 people and there are two towns with over 2,000 inhabitants (San Gregorio del Polanco and Ansina). There are 10 places with 100-1000 people and 11 with fewer than a hundred inhabitants: in part this is a result of the large area covered by the province. Perhaps because of this, it has 16 per cent of rural population which is slightly higher than in Durazno.

With respect to age distribution, the most densely populated settlements tend to have more than 10 per cent of elderly people (65 or over), for example in Tacuarembó, Paso de los Toros, San Gregorio del Polanco, Ansina, Achar and Curtina. Proportion of children under 14 varies from 25-38 per cent depending on locality with a provincial average of 28 per cent. More than half the towns and villages have less than 60 per cent of the population between 15 and 64 years old and thus eligible to work (San Gregorio del Polanco, Ansina, Curtina, Achar, Tambores, Paso Bonilla, Clara, Pueblo del Barro, Piedra Sola, Sauce de Batoví, Chamberlain, Cardozo, Cerro de Pastoreo and La Hilera). The only localities that show percentages higher than 70 employable are Balneario de Iporá, Rincón del Bonete and Laureles. Similar to Durazno, 85 per cent of houses are occupied although there are variations between settlements.

East of Paysandú

In Paysandú, out of the seven localities included in the study, only Guichón has a population of over 5,000 people, the rest have populations below 1,000 and in Villa María there are less than a hundred people.

Regarding age distribution, there are four localities with an elderly population above 10 per cent of the total: as Guichón, Piñeira, Piedra Sola and Villa María. All localities have more than 50 per cent of the population between the ages of 15 and 64 years and therefore eligible to work.

Although 85 per cent of houses are inhabited this disguises major differences within the part of the province within the study. There are only two localities (Paysandú and Guichón) where the rate is above 80 per cent and the remaining five all have more than 25 per cent uninhabited houses.

East of Río Negro

In Río Negro, the two localities covered by the census, are in the east of the province: Grecco and Sarandí de Navarro, with populations of 726 and 269 people respectively. In Grecco 30 per cent of the population are children and 54 per cent adults between the ages of 15 and 64. In Sarandí de Navarro, the relation is similar, 34 per cent children and 50 per cent are adults.

Regarding the number of houses that are inhabited the latest figures are 83 per cent in Grecco and 68 per cent en Sarandí de Navarro.

Table 29: **Summary of key socio-demographic indicators for the four provinces**

Variable	**Tacuarembó**	**Durazno**	**Paysandú**	**Río Negro**
Total population	90,489	58,859	113,244	53,989
Proportion living in urban areas	84%	88%	92%	87%
Ration of men to women	50%-50%	50%-50%	50%-50%	51%-49%
Working population (15-64 years)	61%	60%	60%	61%
Viviendas / hogares	32.298 / 28.054	20,778 / 17,779	38,133 / 33,691	18,431 / 15,786
Tasa de Desempleo (ENHA – Oct. 06) Inf. para el total del país.	Total for the country: 9.7 % Montevideo. 9.7% - Interior of the country: 9.7% Hombres: 7.3% - Mujeres 12.6%			
Human Development Index	0.828 (lugar 7)	0.837 (lugar 8)	0.831 (lugar 11)	0.837 (lugar 12)

Local stakeholder opinions regarding the proposed plantation

A large series of plantation projects brings major changes to rural communities, which may already be experiencing considerable social upheaval. The promise (from some peoples' perspective the threat) of a pulp mill adds to the questions that local communities have about the impacts of the project. The fact that in this case the plantation is foreign-owned raises additional concerns. Many people are happy to speak on behalf of local communities but in this study we made an attempt to give people a chance to speak for themselves by using a team of anthropologists to carry out a series of structured interviews in ten communities within the plantation landscape. Below is a summary of the thoughts and opinions from the region, followed by a more detailed breakdown of opinions from some of the communities.

The following communities were involved:

1. La Paloma – Durazno
2. Blanquillo – Durazno
3. Villa Carmen – Durazno
4. Pueblo Centenario – Durazno
5. Paso de los Toros – Tacuarembó
6. Clara – Tacuarembó
7. Zamora – Tacuarembó
8. San Gregorio – Tacuarembó
9. Grecco – Rio Negro
10. Guichón – Paysandú

In all, 83 interviews were carried out – a full list of the people involved and their positions is given in Appendix 4.

Forestry and cultural change: Building a new work identity

Large-scale forestry in a traditionally agricultural country implies a substantial cultural change in rural areas. It is not only a new production system but also requires new behaviours and new collective imagery. Although the production model is similar to the traditional ranching model as regards workers depending on employers, certain changes are foreseen.

The relationship between the farm labourer and the owner is substituted by that of a forestry worker and a "faceless" company. Workers, who in the past dealt with the foreman, the skilful right-hand man of the owner, now deal with contractors, who are often outsiders – in many cases from Rivera (one of the 19 administrative districts of Uruguay, on the border with Brazil). For workers, forestry work is equated with contractors. Although they know they are separate companies, to date forest companies in general, and especially Stora Enso, have been absent.

Changes in employment status are also significant. Forestry is characterized by seasonal patterns whereas farms are a source of stable work. Moreover, the eight-hour shift in forestry contrasts sharply with the round-the-clock availability of farm workers. Inclusion of seasonal and permanent workers in the social security system is an improvement brought about by forestry and highly valued by local communities. Testimonies also mention other benefits, including transport to and from the work place, food, and safety gear for crews.

Traditional rural workers enjoy a certain degree of independence, knowledge and expertise are handed down from generation to generation or learnt by observation, and performance is evaluated on the basis of how the task is performed rather than the amount of work done. Forestry crews, however, are assessed on the basis of quality and quantity of tasks accomplished forcing rural workers to readapt to this new set of criteria.

Inexperience and the fear of losing opportunities push rural workers to attend training courses; yet another change since now they require formal knowledge to perform tasks.

Workers, the community at large, and educators in particular, appreciate the fact that forestry workers can return to their homes at the end of their shifts instead of staying overnight on the farm or plantation as per the usual practice.

In short, the changes mentioned confer dignity on rural work, make workers feel cared for and that their basic needs are being fulfilled.

From the anthropological point of view, the substitution of agriculture by forestry can be interpreted as a loss of the ranching work identity and/or as processes of cultural change and emerging concepts of the "rural being".

Economically depressed and with previous experience in failed development projects, these communities feel the pressing need for new projects and sources of employment. In the absence of local and national proposals, forestry would be quickly accepted without concerns regarding lifestyle changes in relation to rural work or deep analysis of potential benefits versus liabilities connected to forestry.

Gender issues

Female employment in forestry, whether in nurseries or plantations, is one of the main changes brought about by forestry in the area.

Female harvester operator, southern Uruguay

Nigel Dudley

For the women interviewed there is a "before" and "after" feeling. Female employment opportunities in the towns studied were almost nonexistent, with the exception of traditional low-paying female work such as cooking and house cleaning. In the communities where women have already started working in nurseries or in plantations, there is a feeling of pride on breaking into this traditionally masculine line of work. Furthermore, in some tasks, such as herbicide application and operating the harvester, women have equalled or outperformed men.

Changes in the family structure, in power relations between spouses and in gender relations outside the family are a consequence of female employment. Yet another emerging factor in local social structures worth noting is the potential economic independence of women.

Lastly, women have made huge inroads into the rural labour market, which puts them one step higher in a social sense, giving them a new status within the community and producing changes in social and family situations

History – decline of the railway system and emergence of forestry

Accounts and documents reveal the construction of the railway system by British companies resulted in a chain of settlements and towns springing up throughout the country. The genesis of most towns was closely connected to the arrival of the railroad lines that brought jobs and communication with the rest of the country. The deterioration of the railway system that began in the 1970s resulted in social and economic decay of railway stations and surrounding towns (in Paso de los

Toros, for instance, the number of workers dropped from 600 to 100 at present). Town dwellers reminisce about those by-gone times and feel “forsaken” and “forgotten”. The road network is no substitute for the railway system because it fails to provide protection and organization to locals who miss the orderly speeding of trains along the lines.

Ever since, a number of replacement projects of varied scope have been proposed, but in the end all turned out to be unsustainable. In the 1960s for example, Metzen y Sena started exploiting the kaolinite quarries near Blanquillo. Throughout that decade, the quarries were the main source of employment, but soon mechanization replaced workers. Other projects in tourism, crafts, etc., have generated expectations but failed to deliver. Although one of the aims of the study was to identify new projects, none was found.

Almost everyone believes Stora Enso has the “power” to give life to rowns and villages…however locals know booms are not long-lasting.

Stora Enso, a well-established, internationally renowned forest company based in Europe, is often considered the sole alternative for community development in view of local history. Almost all sectors of society believe Stora Enso has the “power” to give life to towns and villages that will derive benefits from the company’s project. There is a “before and after” of Stora Enso and other forest companies (for instance in Blanquillo). In other towns, where forest companies are yet to arrive, expectations are high (for instance in La Paloma). The arrival of crews or workers seeking jobs in the forest industry has resulted in a population increase, reminiscent of the golden days when towns and villages were founded by railway employees.

The region flourishes with the hustle and bustle of the new founding period. Large projects offering plenty of jobs attract workers that flock to the area. Locals are starting to believe once again that “it’s all for the better”, in the words of an interviewee in Clara.

However, locals know booms are not long lasting. They ask themselves incessantly how long the forestry bonanza is going to last, a concern voiced by several interviewees, including those that express the staunchest support for forestry. Community action and communication strategies should include expectation management aspects.

New conflicts of conscience: more jobs verses environmental uncertainties

Debates about environmental issues connected to forestry are, to a certain extent, a novelty in farming. The concept of sustainability dating back to the 1980s was part of the discourse of agricultural engineers and government officials. Now for the first time in the country’s history, an environmental debate rages over a rural issue. In the mid 1980s, rice and the associated water requirements that posed a threat to wetlands in eastern Uruguay were debated. Although progressive shrinking of fresh water bodies could be considered a global issue, the debate was within Uruguay’s borders and had to be solved in Uruguay. Environmental issues and threats connected to forestry reach Uruguay through international and foreign mass media and the cause is quickly embraced by national and international environmental groups.

How do towns and villages experience the phenomenon? According to interviews, in general forestry is perceived as a job generator. Even for the few interviewees who mentioned that seasonal employment is a critical issue, lack of other options makes forestry “better than nothing”. However, varied levels of uncertainty permeate the welcome of forestry in general and of Stora Enso in particular. Interviewees in general, with the exception of those in specific production sectors, mention social benefits and ask questions about environmental issues without taking radical stances. Testimonies within this same group that do not fall in this category were exceptional, such as the teacher in La Paloma.

Water as a resource is one of the main concerns voiced by interviewees. Information sources from abroad denounce desiccation of certain ecosystems due to Eucalyptus plantations and local knowledge has been acquired by observation and personal experience of farmers or rural workers.

Plantations bring dramatic visual changes to a flat, open landscape like the one in Uruguay.

Forest fires are another source of concern, especially in towns or villages that are surrounded by trees (Grecco for example), whereas agrochemicals and erosion do not appear to be a widespread concern.

Landscape changes due to plantations are not considered a problem in general, though interviewees mentioned local issues and voiced strong personal opinions. Some interviewees in Blanquillo and Clara for example, consider that the surrounding plantations make the place “look like a European country”, as if it were “the first world”. A livestock farmer in Zamora, however, says “I feel as if I were fenced in”.

Certain animal species considered as pests associated to woodlands are a considerable source of concern that will be dealt with further on.

Socio economic benefits outweigh possible environmental damages and environmental groups opposed to forestry seem to have little influence in shaping public opinion. Nonetheless, in Uruguay forestry and connected environmental issues have been seriously questioned and information is often contradictory. Testimonies give evidence of an unsolved conflict owing to a lack of clear answers to questions about forestry as a new production system.

Forestry from the point of view of other sectors

Perspectives were collected from a range of people who will not be working directly in the plantation or relying on it for their income.

Fishing communities

Fishing is a way of life and part of the culture in Paso de los Toros, San Gregorio de Polanco and Centenario. Individuals as well as formal spokesmen of cooperatives, such as Copehum in San Gregorio, believe forestry and fishing are not incompatible. Forestry is not seen as a threat in itself to fish, a natural resource being exploited for economic purposes. As fishermen, they voice their concerns regarding agrochemicals that will eventually leach into the Río Negro basin, contaminating watercourses and therefore destroying the habitats of fish species.

Some interviewees mentioned they would rather combine fishing and forestry. Fishermen in San Gregorio, who are grouped in a cooperative, mentioned they would be interested in neutralizing the seasonality of both jobs, planning forestry peak seasons and fishing peak seasons so that they do not overlap, allowing them to move from one job to the other. Fishermen in Paso de los Toros and Centenario are yet to organize themselves, but they perceive forestry along the same lines as in San Gregorio. Seasonality characterises both fishing and forestry. Fishermen envisage a way to combat and minimize seasonality using watercourses for log transport, profiting from their in-depth knowledge of the river. According to their own testimonies, they would be following the steps of countries with logging tradition and enough available watercourses suitable for log transport. In summary, fishermen seek to become partners of forestry instead of confronting it.

Tourism

In towns with a strong inclination towards tourism, such as San Gregorio, the population at large, the tourism sector and connected sectors (commerce, handicrafts, real estate agents, etc.), were concerned about the proposed location of the mill. Locals oppose the building of the mill in the vicinity or upstream of the Rincón del Bonete dam, on the grounds that it is a tourist destination heavily reliant on natural beauty. In Paso de los Toros, however, these concerns were not voiced. Employment is a pressing concern and tourism is not sufficiently developed so forestry is viewed positively as a potential source of jobs.

In general, forestry is not viewed as threat to tourism. Although far from unanimously, the changes in landscape are met with approval. Areas that were once vast, empty plains are now covered with trees.

Farming communities

The deepest questioning of forestry comes from livestock farmers and ranchers who face pressing conflicts: demand for land and labour. This sector has felt the previously mentioned cultural changes more sharply than any other one and resents the state benefits granted to forestry. Nevertheless, interviewees cannot ignore the upsurge in forestry projects and are beginning to think of forestry as a partner. This partnership involves in-depth study of the possibilities offered by agroforestry, breeding mares for the pharmaceutical industry and planting some of the low profitability land within their ranches with trees, on their own or through contractors. Ranchers interviewed showed a cautious acceptance of plantations and moderate expectations as to the compatibility of plantations and traditional livestock farming.

Opinions differ within the sector. According to qualified interviewees, older traditional ranchers are the most doubtful as to the benefits of forestry, whereas younger generations seem more or less open to making the two sectors compatible.

Wine and vineyard sector

This sector has played an important role in towns with a strong wine making tradition, such as Villa Carmen, where inhabitants feel a historical link to wine making. This link is felt most strongly among older generations who remember the golden years of vineyards. At present, forestry is not seen as an obstacle to new projects in this sector. Interviewees, including those directly involved in present wine and vineyards projects, see forestry as well established in the surrounding area. Forestry has had a strong impact on the town’s everyday life, creating jobs and thereby promoting the financial well-being of its inhabitants and distributing income in the area. Besides, local vineyards produce wine on a small-scale for commercialization in local shops.

Beekeepers

Eucalyptus species being planted are controversial. According to some beekeepers, these are not good sources of nectar while others state that plantation management does not take into account nectar gathering cycles, preventing beekeepers from reaping profits. From the social point of view, forestry is considered positive. In some specific cases, however, such as in San Gregorio, interviewees believe forestry is not compatible with traditional agriculture. In Villa del Carmen, on the other hand, beekeepers believe honey opportunities have sprung up with the arrival of Eucalyptus. Consequently they consider forestry brings not only social benefits, but also benefits for beekeepers.

Conclusions

The study was conducted in ten towns comprising eighty eight testimonies and provides a general diagnosis of the current situation of towns and villages in relation to forestry. Designers of company social policies to be implemented will find in this document ample reference to the socio cultural reality of the area under study.

Future research issues arise from the field work carried out. Among these it is worth mentioning in-depth analysis of ranching, fishing and forestry labour identities in rural areas and their complementarity; changes in gender, family and poverty issues caused by forestry; historical building of towns after Stora Enso's arrival; the local cultural construction of "environmental issues" and how existing productive systems impact on them, among others.

National stakeholder opinions regarding the proposed plantation

To check: The translation (or perhaps the original text) was unclear – I had to guess in places, so this needs checking with the original and possibly going back to the authors

A series of interviews were carried out during March 2007, in a process that aimed at identifying and then talking with major stakeholders interested in forestry and plantation development to gauge opinions, hopes and fears in this sector. In all, 31 national stakeholder groups were identified and selected individuals approached for interview – a full list is available in Appendix 5.

The Interview guidelines were drawn up bearing in mind major research issues and also the main arguments discussed in the media, with the aim of identifying current issues and recognising the different positions of the national stakeholders (see summary of main questions in Appendix 6). In all, 16 interviews with national authorities, representatives of producers associations, academics and provincial stakeholders of Durazno and Tacuarembó were carried out from March 7th to 20th.

Opinions regarding national forest policy

There is a broad consensus among all the stakeholders interviewed that the Forestry Law of 1987 that aimed to encourage plantations had a positive impact on the country. The acceptance of current State policy on forestry by all the major political parties marks a rare political consensus in Uruguay. Historically, the country has focused on livestock, although there have also been considerable efforts to promote agriculture. Development of plantation forestry was only possible due to the incentives offered to the sector. Nowadays, several different production models can be identified in terms of final products from plantations: the south of the country tends to produce pulp; the littoral and centre produce a mixture of pulp and sawnwood, while the north has focused mainly on sawnwood.

Following these basic agreements, opinions start to differ about the importance of forestry for the country although there is agreement that the change of government in 2005 also marked a distinct change of direction in forest policy.

- ✓ National authorities generally regard government policy as having fostered plantations and helped to create a critical momentum towards plantations within the sector, but with weak integration with other sectors

- ✓ From the academic field, producers associations and provincial stakeholders, it is acknowledged that the policy was successfully implemented to generate enough raw materials to help start an industry. However, some stakeholders emphasized that the model promoted forestry based on direct foreign investments, which is regarded as negative

In general, the main concerns about the impact of the model are:

Key concerns relate to land tenure, risks of displacement, presence of outside workers, poor dialogue with local communities and farming community and lack of information

- ✓ Impacts on land tenure
- ✓ Displacement of the rural population
- ✓ Hiring of outside workers
- ✓ Poor dialogue between plantation companies and local residents
- ✓ Lack of interest in developing outgrower schemes and other collaborations with small producers
- ✓ Scarcity of information and public research on environmental impacts of plantation forestry
- ✓ Lack of contact between livestock farmers and the forestry sector.

Interviewees tried to identify some common forestry policy guidelines from the new government, but although there was consensus in identifying concrete measures, there was lack of agreement about what direction policy should be taking. Some important legal and policy steps are outlined in the box below.

Do we need this?

Box: Recent legislation and policy initiatives affecting the sector

- ✓ Repeal of decree 333/90 (accessory lands)
- ✓ Repeal of decree 330/90 on subsidies
- ✓ Re-classification of forestry soil which included quality species
- ✓ Tax amendment given to pulp plantations
- ✓ Decree on previous environmental permit by DINAMA on surfaces above 10,000 ha
- ✓ Guidelines for forestry transportation
- ✓ Repeal of indirect tax refund to log exports to be sawed (under development)
- ✓ The third parties and Corporations Law, while covering more than plantations, is recognized as having been inspired by this sector

Although these policy initiatives have certainly helped to set the direction for forest policy there is little consensus about where it will go from here, either inside or outside the government. It is recognized that subsidies are no longer needed to promote the sector, although also that their removal may damage small producers, who are once more excluded from this sector. The national authorities believe that the current dominant forestry model will continue to play a leading role, although they want to introduce measures the better to promote integration of national producers into the sector and to create better working conditions. They stress the need to develop a strategy to add more value to the pulp industry and to improve integration of the forestry and livestock sectors.

The national authorities admit there is some degree of internal disorganization with respect to national forestry policy and there is clearly sometimes a lack of internal coordination and of joint vision. Workers in the academic and research fields are trying to keep up with changes in policy, with major developments relating to species diversification, silviculture projects and implementation of the clean development mechanism. Producers associations see lack of coordination and gaps in the current model of forestry development which cause uncertainty due to the fast rate of policy change and lack of stakeholder consensus.

In general, there is agreement on the need to move towards a more integrated approach in which the plantation industry would be one more part of a broader approach to development, with higher-value products and better integration between producers, including the small producers. However, there is disagreement about the possibility of this: some stakeholders believe it is possible or even in progress while others think that the market-based model will continue to be dominated by a few large players.

Specific aspects of forest policy

Changes in the tax law

Most interviewees thought that eventual removal of subsidies to the sector had been planned even when the original law had been set, and the government's actions had simply accelerated a process that was going to take place anyway towards 2007. There was some feeling that there was still insufficient clarity about the period of time in which subsidies could be kept and a general recognition that default on subsidy payments had created problems. No-one thought that removing the subsidies would affect the development of the sector, because the sector is already running and new companies do not regard it as a requirement. Some believe that the subsidy was never really needed to promote the sector or attract investments. Academics argued for special subsidies to help small producers although this was not mentioned by producers associations.

Tax exemptions on forestry soils

Currently forestry operations do not have to pay tax to local authorities. There are two clear opinions about this: national stakeholders regard it as unimportant because they think that forestry will bring economic dynamism to the area, while local authorities disagree and believe that the national government is reducing regional autonomy. Even though the latter acknowledge the positive socio-economic impact the sector, they have concern that loss of tax revenues will make it more difficult to maintain and repair provincial roads. Indeed the issue of the impact that forest development will have on roads has been discussed since the 1990s without clear policies emerging. Infrastructure has historically been one of the main election issues at a local level but only has a minimal impact on voting at a national level and there is concern that as a result the national government does not take it seriously. National authorities believe that a concrete tax can be negotiated to support road infrastructure but there remain disagreements on the ways in which this might be collected or implemented. There is currently no discussion about reviving the rail network. In general, there continues to be only a weak relationship between government and companies: the latter fear that the government has changeable policies while the former regard their relationship with companies as being based on lobbying with a relatively narrow vision and little opportunity to build the sector together.

State capacity to monitor the forestry sector

Monitoring of the forestry sector is identified as a serious weakness

All the interviewees were concerned that the state did not have the capacity to monitor the economy in general and the forestry sector in particular. In general, it is considered that important changes are needed in the government's approach, to develop a clear strategy with respect to monitoring and assessment, including making sure that mechanisms to collect and assess data are in place, which itself will require the creation of integrated data management systems.

Labour market

There is little consensus on net labour gains or even which parts of the plantation process create the most jobs and there is a lack of research to help clarify the situation, although it is recognised that different stages of the plantation process have different employment implications:

- ✓ The evolution of **tree nurseries** is generally believed to have been positive for Uruguay because prior to this, companies imported the plants
- ✓ **Plantation** work is recognised as cyclical – the establishment phase uses the most people although maintenance is generally better paid
- ✓ The wood **industry** (pulp mills etc) is generally thought to produce more constant and permanent employment, located in urban centres, but is still only poorly developed
- ✓ **Services** for the sector is an important additional dynamic factor for the economy

There is concern about the quality of employment, particularly in the past and perhaps due to the very rapid growth of the sector. Those improvements that have taken place are believed to have been mainly as a result of regulation and enforcement, sometimes driven by outside forces such as certification requirements or by contracting companies themselves. In general, contracting companies are singled out as a very different type of entity within the field, requiring different approaches. There was no clear agreement about the extent to which regulation of this sector is needed, some people believing that it stifled investment while others felt it was essential to maintain workers' rights. Many interviewees stressed the unique nature of the forestry sector but also that it had to develop and grow, for example through agreement of stronger codes of practice etc. Formation of syndicates is regarded as one way of helping to address these problems. Lack of training is identified as a problem although one that many people felt should be addressed first by the companies themselves.

Vision of the forestry sector in relation to other sectors

There is concern that the forestry sector is isolated from other sectors, including particularly livestock and agriculture

Everyone appears to think that the forestry sector is relatively isolated from other productive sectors in the country. However, while the government believes the forestry sector isolates itself, other stakeholders think the reverse; i.e. that forestry is being isolated by other sectors of the economy, particularly livestock and agriculture, which have a powerful lobbying capacity. Nowadays, the forestry sector appears to be gaining ground in this respect according to the interviewees. However, at a production level, complementarity among the sectors can be theobserved, promoted both spontaneously and through actions by the government. Underlying this is recognition that plantation forestry is a growing sector of the economy, driving development and with clear strategies for development and increase in export markets.

Within the forestry sector itself, there appears to be an established relationship between big companies and small producers. There is, however, some confrontation based mainly on the disadvantages that small producers face regarding access to land and the restrictions promoted by the big companies, which it is felt leave many of the small producers behind. At present there are two opinions about the way forward: on the one hand a suggestion that large companies should integrate smaller ones into their operations by means of contracts or agreements; on the other that small companies should unite together, although it is assumed that this option would require state support and there are no clear policies for this as yet.

Assessment and future vision of the sector

Interviewees agree that the view of forestry reported by the media originates mainly from opinions within Montevideo, whilst a truer picture comes from the rural population itself. A similar situation occurs with respect to the agricultural and livestock sector. However, there is throughout a tendency to have a rather cool and initially negative opinion about plantations, which has been greatly influenced by current debates on the installation of the pulp mills, ideological issues regarding foreign investments and environmental factors. Some of the antipathy has deeper roots in a country that is based around the livestock and agricultural sector and has probably been intensified by lack of information from the plantation sector and inappropriate handling of some controversial issues.

In summary, there is consensus that the forestry sector – all the way from government institutions to companies – has not led the development process in a systematic, consistent or consensual way, nor has it provided sufficient information about planned activities.

There was general consensus that for more research was needed within the sector and a list of topics could be identified

All interviewees were concerned about the small amount of research that the sector has generated. In general terms, gaps in information relate to technologies that ensure the maintenance of the environmental resources, general research on the production process and industrial development, management and the wood industry. There is recognition of the need to develop this sector within Uruguay. Whilst it is acknowledged that companies pay for much useful research, this is generally not communicated from the private to the public sector. Interviewees identified a number of important research elements, outlined in the box below.

Box: Research needs identified by stakeholders

- ✓ Monitoring and evaluation and use of results
- ✓ Provincial information systems regarding labour and company statistics
- ✓ Inventories of forestry sites
- ✓ Social impact of the plantations with respect to workers and local communities
- ✓ Characteristics, technology and use of woods (for example ethanol production and sawnwood drying by means of ultrasound)
- ✓ Best practice with a variety of species
- ✓ Environmental impacts on soils (soil degradation); water (impact upon the quantity of surface water and groundwater, also on its quality); biodiversity (impact upon biodiversity in general and in relation to the campos)

Assessment of the forestry sector

There was a marked difference of opinion between interview groups regarding opinions of the sector, summarised in Table 30 below (some are general comments; others appear to refer to specific projects).

Table 30: **Opinions regarding development of the plantation sector**

Stakeholder	Positive opinions	Aspects to be improved
OPYPA-MGAP: Planning and Agricultural and Livestock Policy Bureau- Ministry of Cattle, Agriculture and Fisheries	Creates dynamic expectations	Highly centred model, does not integrate small and medium companies and complementary activities
	Diversifies the Uruguayan economy (agricultural, livestock, industry, exports).	Better State regulatory and managerial capacity, both regarding environmental planning and assessment
	Generates direct and indirect employment	
DGF – MGAP: General Bureau of Forestry- Ministry of Cattle, Agriculture and Fisheries	Generates local employment	Invested capital was above the decree law and environmental issues
	Develops workers' organisations	Existence of subsidies has skewed the sector
	Rise in the macro economic rates	High concentration of land ownership
MTSS-IGT: Min. of Labour and Social Security- Labour General Inspection	Possibility of creating good jobs	Permissive state attitudes helped create bad working conditions
		Environmental suspicion concerns our people
MTSS – DINAE: Ministry of Labour and Social Security- National Bureau of Employment	Generates employment in the provinces in harsh economic periods	Jobs have low levels of security
	Regenerates the social tissue and economic distribution.	Predisposition to generate "slave" labour.
		Predisposition of contractors to avoid their responsibilities

Stakeholder	Positive opinions	Aspects to be improved
MIEM – Mesa Tecnológica: Ministry of Industry, Energy and Mining-Technology	Generates employment	Economic and political interests could divert attention
	Generates export exchange for the country	Environmental concerns
	Incorporates technology	Migration of rural population due to land concentration
DINAMA – MVOTMA: Nat. Bureau of Envt- Min of Housing, Territorial Organization and Environment	Improves the living conditions in the countryside and in the country generally	Concentration of land ownership
	Promotes employment in the countryside	
	Improves conditions regarding livestock and biodiversity	
F. AGRONOMIA: School of Agronomy	Successful	More training at an intermediate level
	Attractive internationally due to the conditions of the country	Develop incentives for high quality management
INIA: Nat. Bureau of Ag. & Livestock Research	New economic area	Difficult to reach consensus in a newly developing area
	Research opportunities are attractive since it is a new field	
CIEDUR: Centre of Interdisciplinary Studies on Development	Long term coherence	Environmental impact
	Specific policies are formulated	New state policies are required
	New investment opportunities for some parts of the country	Foreign investment creates enclaves
CLAEH: Latin American Centre of Human Economy	Generates employment and dynamic economic conditions	Disorganized early stages with lack of clarity about where products would be used
	Chance to promote the integration of different local capacities.	Social impacts of increased displacement
	Generates services and conditions which did not exist previously	Events happening too fast without enough discussion
AIAU: Uruguayan Association of Agronomists	Successful project, aims were settled and accomplished	Integration with agricultural and livestock sectors, promotion of mixed models
	Increased value of rural land	Predominance of big foreign companies
	Develops industrial base in the rural areas	Aim at more valuable species and processes
SPF: Uruguayan Association of Forestry Producers	Generates employment in the rural sphere	Lack of integration with agricultural and livestock
	Alternative options for low profit livestock areas	Communication from the sector to the rest of society
	Good planning and land organization	Mistakes due to lack of research
Asociación Contratistas Forestales: (Forestry Contractors)	Generates employment in the countryside	Causes increased inequality in rural areas
	Sustainable production with positive environment balance	
	Generates exchange	
ADT: Diagnostic Analysis beyond frontiers	Economic development and growth of service sector	Rapid, monoculture-based process
	The big companies have set positive regulations	Inequality due to support for large companies
IMT: Borough Hall of Tacuarembó	Generates employment	Government subsidies and rural contributions in particular
	The sector contributes to provincial & national economy	From the environmental point of view, it remains unclear what happens once the woodlands are exploited
	Productive sector, attractive to foreign investment.	
IMD: Borough Hall of Durazno	Generates employment and wealth	Tax exemption is too large and interpretation of law is unclear
	Early vision for plantations Environmental reserve created by plantation woodlands	Bad working conditions Non- discriminated exports of non-industrialized wood

Future developments

There is consensus that the current model will continue and some major growth is expected in the next 10-15 years. Greater attention needs to be paid to the social aspects of the development and particularly promotion of complementary activities among the different productive sectors. In general there is a hope that in future there will be a better balance between large and small companies although the latter are still expected to lead the process.

Some issues to be considered by Stora Enso

Getting stakeholders to discuss concrete actions was difficult and tended to create tensions within the interviews, but the following points were generally identified:

- ✓ Promote **social dialogue** with stakeholders and local authorities, remaining open to criticism and social consensus
- ✓ Define **clear communication strategies** that explain what is happening to local stakeholders
- ✓ Promote **forestry training** and options for gaining **local qualification**
- ✓ **Make activities known** including holding meetings with the local people in order to inform them of the impact the company will have on the area
- ✓ Promote **codes** of social and company responsibility
- ✓ **Decentralize the company** regarding decision making
- ✓ **Promote research** together with other national or provincial stakeholders to foster a proactive attitude of the company and its commitment to the development of the sector in the country
- ✓ **Promote dialogue instances with other sectors,** through existing producers associations

World Rainforest Movement

The World Rainforest Movement, based in Montevideo, has been the driving force behind a global campaign against industrial tree plantations (e.g. Carrere and Lohman 1995, Carrere 1999). Not surprisingly, WRM has also focused attention on plantations in Uruguay, including in particular a recent report criticising four Forest Stewardship Council certificates awarded to plantation companies in the country (Carrere 2006). The detailed critique includes many of the issues that are high on the list of concerns amongst plantation critics around the world and as such provides a valuable checklist of issues that Stora Enso needs to address in the current project. The following table summarises key concerns raised in the FSC critique, followed by a list of additional issues raised in conversation with local communities (Carrere 2006).

Table 31: **Concerns about plantation certification in Uruguay from the World Rainforest Movement**

Topic	Issues
Water	Lack of analysis of impacts No monitoring of water quality
Soil	Poor management leading to erosion of gulleys Impacts of heavy machinery for harvesting
Biodiversity	Poor data on rare / endemic species in plantation No policies for rare or endangered species Lack of information about or concern for grassland habitats
Agrochemicals	Use of agrochemicals banned by the FSC (particularly for ants) Lobbying to change the FSC rules to allow more hazardous chemicals Poor safety standards for workers
Employment	Plantations have resulted in fewer jobs than previously available on farms Poor management of outsourced tasks from both a social and environmental perspective Antipathy to organised labour and trades unions (sometimes intimidation) Lack of training programmes
Social issues	Failure to control exotic animals (boar etc) in plantations leading to crop damage etc Poor community relations, out of date contacts, lack of information to stakeholders Lack of support (or an outright ban on) apiculture

Comments from stakeholder interviews carried out by WRM:

- ✓ Wells dried up as a result of plantations
- ✓ Freshwater ponds and streams dried up
- ✓ There has been an increase in poisonous snakes (because the garter snakes that usually prey on them have disappeared due to drier conditions)
- ✓ Agrochemicals have been poorly controlled leading to contamination of workers
- ✓ Poor training facilities were provided
- ✓ Rules were broken – e.g. heavy lorries used dirt roads in the wet season causing damage

The preceding table and list is a summary of key points and does not attempt to cover everything raised in the report.

The Historical Environment

To check: needs references added

The following overview of the historical importance of the proposed plantation areas is based primarily on bibliographical and cartographic information and analysis of satellite photographs, as well as studying archaeological collections from the area. To help set the context, the box below outlines the main historical periods in Uruguayan history and prehistory: the use of photographs and collections are described overleaf.

Box: Timeline of history in Uruguay

- ✓ **Paleo Indian or First American Period**: 12,000–9,000 - Before Present (BP). Indicator: presence of "Fell I" or "fish tail" projectile points. Environmental characteristics: end of the glacial period, significant modification of the environment and landscape, extinction of pleistocenic megafauna. Numerous records on littoral sites of Middle Negro River and Tacuarembó River.

- ✓ **Archaic Period**: 9,000–5,000 BP. Indicators: high stylistic variability of projectile points (sizes and shapes.) Polished artefacts (*rompecabezas* – a weapon with two iron or lead balls on a short, flexible handle), mortars, etc. More complex artefact inventory. Environmental characteristics: interglacial conditions. The period ends following a peak in temperature (sea level 5 metres.) Temperature and humidity are higher than now. Numerous records on littoral sites of Middle Negro River and Tacuarembó River.

- ✓ **Post-Archaic Period**: 5,000–2,500 BP. Indicators: some researchers believe the surge in mound construction (mounds without pottery) occurs in this period. Environmental characteristics: climate nearing current conditions with periods of aridness. Human groups have to respond culturally to the change in environmental conditions.

- ✓ **Incipient Formative Period**: 2,500–400 BP. Indicators: a surge in pottery. Mound construction found in the extreme south of Brazil and in the east and northeast of Uruguay. Pottery from the Middle Negro River region shows distinctive characteristics with decorations defined as "pointed" incisions. From this period, the surge in rock paintings (pictographs) is notable. Environmental characteristics: current conditions, with more extensive highland and riverside wooded areas and abundant brush vegetation.

- ✓ **Hispano-Indigenous Contact Period**: 16th and 17th centuries. Indicators: the introduction of livestock (horses, cattle and later sheep) and other non-native species (e.g. canines) transform the landscape, progressively pushing out native fauna. Environmental characteristics: Native flora contracts to highlands and river areas. Large portions of the territory are deforested, leading the way to the prairies of today.

- ✓ **Colonial Period and Beginning of Independent Uruguay Period**: 18th and 19th centuries. Indicators: occupation of territory and consolidation of cattle raising, developing from the "cowshed of the sea" (Jesuits) to the fencing in of the fields. Land registries of the 19th century reflect various technological changes in livestock practices, land tendencies and demographic changes. Noteworthy are the constructions with dry stone technology: corrals, fences, housing, etc. Battles leave archaeological records in various battlegrounds.

Methods

A range of methods were used to collect information, described below.

Aerial photographs

Detecting the prehistoric evidence of the area using satellite photography is not efficient, with the exception of the "*cerritos indios*" (Indian mounds). In this last case, a 1:20,000 (SGM) photograph was taken successfully: nonetheless, the procedure is not able to record low-lying mounds. However, research into the historical evidence of narrowing chutes, corrals and stone fences can accomplished quite effectively by this resource. Aerial photographs 1:20,000 (SGM) and high-resolution satellite images (pixels equalling at least 20m of surface area) are appropriate for detection of these structures. Processing of digital images through use of specific programmes (e.g., IDRISI) may also be useful to facilitate the detection of prehistoric and historical structures over wide surface areas.

Private collections

Our in-house analysis revealed the existence of numerous private collections of prehistoric archaeology of the Middle Negro River, with few references. In five days, 13 private collections of the area were categorized. Respectful personal relationships with collectors led to enriching exchanges. Hundreds of archaeological artefacts were photographed, owners interviewed and information on original locations recorded and entered into the GIS digital mapping system. Valuable empirical observations from the collectors were gathered regarding the various archaeological sites and possibilities were discussed for collaboration in the development of local museums.

Private archaeological collection in San Gregorio

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Arturo Toscano [?]

Table 32: **Private collections in the region that supplied information to the study**

Collection	Location	Inventory	Marked	No. of pieces
Cayetano Álvez	Durazno	No	No	750
Rivera House Museum	Durazno	Yes	Yes	1,000
Séptimo Bálsamo	Paso de los Toros	No	No	1,500
Washington Aizpún	Paso de los Toros	Yes	Yes	2,498
Julio Bálsamo	Paso de los Toros	No	No	300
Muga	San Gregorio de Polanco	No	No	3,000
Julián Machado	San Gregorio de Polanco	Yes	Yes	500
Julio Santos	San Gregorio de Polanco	No	No	50
Juan Pusillo	San Gregorio de Polanco	No	No	250
Luís Rodríguez	San Gregorio de Polanco	No	No	20
Indian Museum	Tacuarembó	Partial	Partial	2,500
Milton Coore	Tacuarembó	No	No	750
Omar Michoelsson	Tacuarembó	Yes	Yes	500
			Total	**13,618**

Summary of findings

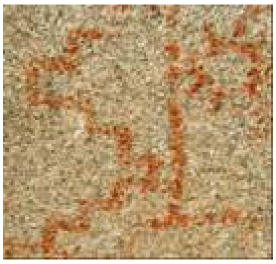
For the purposes of analysis and to help make recommendations regarding conservation of historical areas and artefacts, the archaeological record has been differentiated into two periods: prehistoric and historic.

Prehistoric records

Four main centres of activity can be identified, each with distinctive features:

- ✓ **Littoral sites**: Middle Negro River and Tacuarembó River: settlements often took place along or close to rivers. For example the Middle Negro River has significant prehistoric littoral archaeological deposits: example, thousands of projectile points and *boleadoras* (a type of sling).

- ✓ **Lowland hill mounds**: East of the Tacuarembó River. Indian earth mounds are cultural manifestations of the human groups occupying an extensive lowland territory for several millennia in the southern state of Rio Grande do Sul (Brazil), and the Uruguayan border zone. Excavations in the Yaguarí valley found a mound over 3000 years old, measuring 32 m in diameter and 1.8 m in height (Taddei date) along with ceramics, food remains, bonfires and with a complete human burial site. Over 600 mounds have since been identified from the same valley (López et al 2004) demonstrating the long and complex maintenance of monumental spaces by this culture. Unfortunately hundreds or even thousands of mound structures have been destroyed by agriculture and livestock management and particularly the expansion of rice.



Rock art sites have legislative protection as historical monuments.

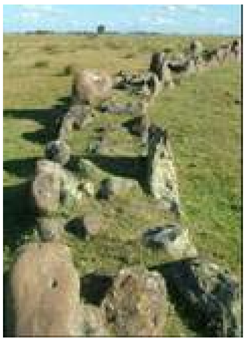
- ✓ **Rock art sites**: Southern Department of Durazno. There is a significant amount of rock art associated with granite outcrops in the central-south region of Uruguay. These are usually on isolated rock surfaces in the open and consist of geometric abstracts and drawings, ranging from a few centimetres to over one square metre, and drawn in red pigment (Fe_2O_3 hematite) covered by a thin translucent silicate layer that preserves them. They are often covered by lichen, which makes detection difficult, and many undoubtedly remain to be discovered. To date, the rock art sites are the only prehistoric archaeology remains to have received legislative protection as historical monuments (Resolution 842/995.)

- ✓ **Stone piles**: It is common to find various classes of “artificial piles” of stones in the hills and elevated areas in Uruguay; these were first described by Darwin at the *Sierra de las Animas* in 1832 (Figueira 1982). Two types have been distinguished: cone-shaped and ring-shaped piles either isolated or in groups and both can be seen at a same hill. Little has been determined about their function or chronology but they have generally been attributed to initiation ceremonies or death rituals, although there has been speculation that the ring-shaped piles might be animal traps. In the Department of Tacuarembó, findings at Charrúa Hill have been reported, but a large part of the elevations of the department have not been surveyed. There is sometimes confusion between prehistoric piles and European dry stone construction.

Historic records

Since European settlement, two main types of records exist:

- ✓ **Rural architecture**: a study of transformations in rural architecture reflects the socio-cultural processes occurring over four centuries of occupation, although records are very incomplete and there is much to be learnt. Rural architecture associated with livestock activity shows various construction



Historical walls and buildings are found on several of the properties bought by Stora Enso

technologies: (1) dry stone (corrals, fences, narrowing chutes, housing and stands); (2) mud construction (straw and sod); and (3) rubblework with plaster or mortar (tubes, bathrooms, sheds, housing, burial sites, etc.) Following a recent visit to *El Arazá* establishment and others in the area, the following states of conservation of dry stone corrals, narrowing chutes and fences could be evaluated on a preliminary basis: (1) ***original***: original function maintained, including maintenance (construction technology maintained or not.); (2) ***modified***: functionality maintained, in association with modern post and wire fences; (3) **abandoned**: loss of functionality, progressive deterioration with invasion of trees and shrubs and partial dismantling; and (4) **dismantled**: some support ashlars, because of extraction to reuse stones.

- ✓ **Battlegrounds and other historic events**: in the area of interest, we found at least 20 sites where episodes not only left their historical memory, but also show related material. When there are documents or remnants from wars, solid references to buildings, notable geographical features (passages, trails, hills, etc.) are explicit. In other cases, when document references are scarce, archaeology can offer the appropriate methodology to identify material vestiges of these events. Precise geographic location of battles is often difficult as many sites are controversial or have never been precisely identified. Following bibliographical research a database has been created and geo-referenced in GIS, classified as (1) reliable / consensus exists; (2) vague or controversial information; and (3) tentative / generic information. The following chronological periods can be distinguished:

1) Colonial Period (17th century – 1811)
2) Artigas Revolution – Portuguese Invasion (1811-1820)
3) Founding of the Uruguayan State (1830-1839)
4) Great War (1839-1851)
5) Caudillo Period (1851-1875)
6) Military Period (1875-1890)
7) Revolutionary Period (1897-1904)
8) G. Terra Dictatorship (1933-1938)

Table 33 below outlines some of the main battle sites in the region under study.

Table 33: **Known battlefields in the plantation landscape**

Battle	Year	Date	Location	Department
Puntas del Yí	1702	6 February	Puntas del Yí	
Guayabos	1815	10 January	Guayabos Stream	Paysandú
Cordobés	1816	November	Cordobés Stream	
Tacuarembó	1820	22 January	Tacuarembó Chico Stream	Tacuarembó
Matanza de Salsipuedes	1831	11 April	Salsipuedes Stream	
Tupambaé	1832	August	Tupambay Stream	Cerro Largo
Yarao	1834	14 May	Near Tacuarembó Chico Stream	Tacuarembó
Carpintería	1836	19 September	Carpintería Grande Stream	Durazno
Yí	1837	21 November	Yí River	Durazno
Molles y Sauce	1844	24 January	Molles y el Sauce Stream	Durazno
Hecatombre de Quinteros	1858	28 January	Mouth of Rolón Stream	Río Negro
San Fructuoso	1863	31 July	Tacuarembó Capital	Tacuarembó
Pedernal	1863	9 September	Pedernal Hill	
Tres Árboles	1897	17 March	Tres Árboles Stream	Tacuarembó
Paso Rubí	1897	25 March	Las Cañas Stream – Paso Rubí	Durazno

Battle	Year	Date	Location	Department
Las Palmas	1904	17 January	Las Palmas or Paso Billar	Durazno
Cerro Dos Hermanos	1904	17 January	Dos Hermanos Hill	Durazno
Cordobés	1904	18 January	Pass at El Cordobés Stream	Durazno
Tupambaé	1904	23 June	Tupambay Stream	Cerro Largo
Picada de Ladrones	1935	4 February	Negro River coast	Durazno

Location of historical “hotspots” with Geographic Information System (GIS)

Spatial location of hotspots was performed by GIS. ArcView 3.2 software was employed to geo-reference sites with their respective databases and basic location references. The GIS was organized into two folders: (1) geographic database: hydrography, main and secondary roads, departmental borders and localities; and (2) archaeological indicators: littoral sites, mounds, rock art, historical sites and battlegrounds. The locations were marked through “points.” However, these represent variable expression polygons on the terrain and must be taken simply as an indication. For improved information management by people unfamiliar with GIS, the project is presented in a self-running executable (Flash) through the ArcEXPLORER 2.0 program (free software.) The program is an easy-to-use digital cartography browser and a user manual is included on the CD (.pdf format.) Specialized usage is possible by copying files D:\fscommand\Sitios (.shx, .shp, .dbf) on the CD for use in GIS programs compatible with ArcView

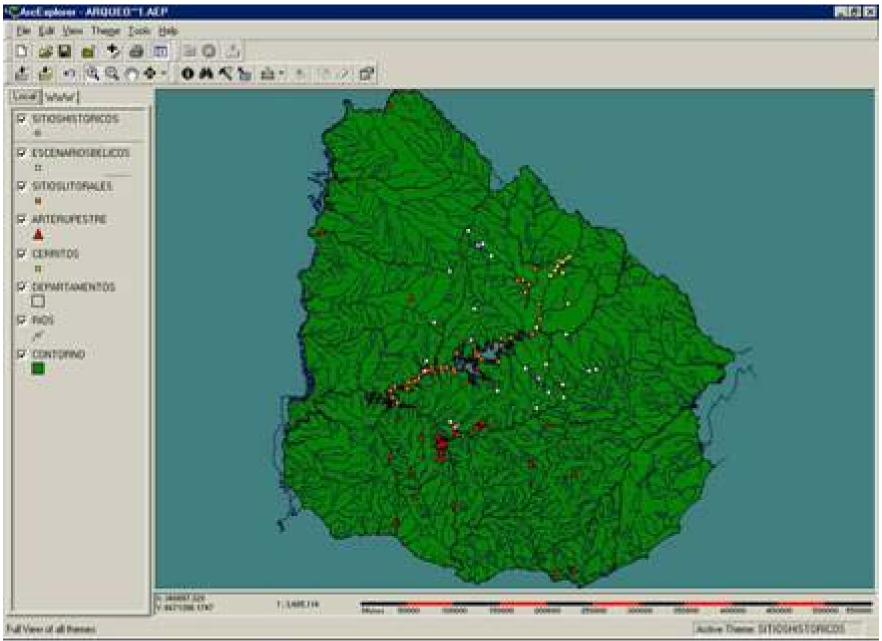


Figure 16: **GIS reference on archaeological and historical sites**

Summary of main findings

In summary, the plantation will need to consider many specific archaeological sites, most of which will not yet have been described or identified, and also a range of more historical sites and landscapes, a proportion of which remain as obscure as those of prehistory.

Some possible indicators

To improve management of the area of study, locations characterized by the presence of relevant evidence material are proposed for archaeological indicators. These include:

- ✓ Prehistoric archaeological finds (camp sites, rock art, mounds, stone pilings, etc.)
- ✓ 17th – 19th century historic housing and constructions (ranch house and stand foundations, stagecoach posts, general stores, burial structures, etc.)
- ✓ Historic narrowing chutes, corrals and stone fences (dry stone)
- ✓ Historic sites where notable events took place of regional or national interest (battlegrounds, meeting places or historic proclamations.)

With these four indicators, diverse archaeological remains can be organized and identified. Nevertheless, it will also be necessary to evaluate the relevance of each site or particular remains. This will need analysis of the value that various stakeholders attribute to particular archaeological remains, drawing on opinions of: (1) local community; (2) national community; (3) the State through departmental and national legal offices; and (4) archaeology as a specialized discipline.

Likely impacts of plantations on archaeological and historical heritage

Forestry can have two types of impact on archaeology: direct effects on archaeological sites and effects on the cultural environment or landscape.

- ✓ **Direct impacts**: intensive forestry can potentially destroy or irreversibly alter archaeological remains. Plantations imply various interventions on the land that impact in a differentiating manner according to the types of archaeological evidence. In the case of prehistoric remains, the preparation and sowing of seedlings can in some cases cause deep cuts in the earth, which in turn would cause partial or total destruction of an archaeological site. Meanwhile, tree plantations may cover and seal archaeological sites making their identification and scientific knowledge difficult (e.g., prehistoric littoral sites on meadows.) In the case of historic records, the conditioning of specific infrastructure (foundations, sheds, etc.) can mean the dismantling or destruction of buildings and other structures of historical value. For an area such as the one under consideration, with poor knowledge of archaeology and no systematic surveying, archaeological studies are therefore necessary prior to forestry activities.

- ✓ **Impacts on the cultural environment or landscape**: UNESCO (1999) has recognized the value of the landscape: “cultural landscapes often reflect specific, viable land utilization techniques having accounted for the characteristics and limits of the natural environment where they are located, as well as a specific spiritual relationship with nature…” (Article 38.) For example, rock art sites require preservation of their surroundings, including geological outcroppings and native forests, as an indivisible unit that together with art forms the cultural landscape. In 1998, the Heritage Commission in Uruguay established an 800-m radius of protection for pictographs. Similarly, battleground scenes are relevant where the demarcation of the area is complex due to the size and vagueness of the location. The alteration of the landscape in these historic locations could imply a deterioration of heritage.

Policy, legal and administrative context

Background

Uruguay has made three attempts to increase forest cover through specific incentive policies (Morales 2006 and interviews):

- ✓ The **1968 Forest Law 13723** used tax exemptions, credit and tax reinvestment in plantations to encourage an increase in tree cover. It is generally judged to have failed, due to regulation not being complete, the Forest Fund was not implemented and priority zones were not defined, and loans were short term.

- ✓ The **1987 Forest Policy Law 15939** aimed both to encourage plantations and to protect remaining native forest. Instruments included tax exemptions, subsidies and credit programmes. Priority zones were classified according to soil quality, with poorer soils (less suitable for agriculture) generally being eligible for support. In all, 645,620 ha were planted between 1989 and 2004, of which 600,669 ha were established in a burst of activity between 1992 and 2002.

- ✓ Current forest policy has reduced the subsidies and made changes to soil classification. It requires more in terms of management plans and environmental impact studies. The **Investment Promotion and Protection Law 16906** retains the tax exemptions and tax breaks, with investments considered as National Interest Projects. There is a free trade zones, but companies located here are expected to pay a canon or fee.

Uruguay policy has thus used strong economic incentives to encourage the plantation industry, linked to fairly tight controls on where forestry is encouraged, based around suitability of soils for agriculture and forestry (the CONEAT maps described earlier). The precise legal status of the designations identified by the soil maps is however unclear. With respect to plantation establishment there are three types of soil distinguished:

- ✓ Priority soils, where planting is eligible for incentives packages, usually soils deemed less suitable for agriculture

- ✓ Soils that are not a priority but where planting is permitted

- ✓ Soils where agriculture is a priority and the government would prefer not to see plantations.

Currently, forestry is encouraged on land that is considered less suitable for agriculture, frequently on poorer soils (although conversely some good agricultural land may be sub-optimal for trees).

Tax incentives and, in the recent past, direct grants have been confined to priority soils, which means that virtually all plantations have kept to areas selected by the government, although this may change in the future as planting becomes less tied to incentives. It is not entirely clear whether overall plantation productivity could be increased by planting on some of the other soil types, nor exactly what the legal situation would be if plantation owners ignored the zones suggested in national soil maps.

In addition to those laws and policies directed specifically at forestry there are a range of other laws affect plantation forestry and related land-use or conservation issues: some of the most important are outlined below.

Legislation relating to water resources

A recent amendment to the Constitution of Uruguay states that Uruguayan water resources belong to the State, may not be privatised, and may only be managed by legal state entities. In addition to the provisions set forth in the Constitution, the Code of Waters (Law Nº 14.859) determines the norms that regulate the waters in Uruguay. Responsibility falls mainly to two entities:

- ✓ **National Direction of Hydrography** (DNH), part of the Department of Transport and Public Works (MTOP): DNH plans use and sustainable development of water resources, ports and coastal works and enforces regulations.

- ✓ **Obras Sanitarias del Estado** (OSE - the State Water Works) is responsible for the supply of drinking water. It services 2,996,750 inhabitants in 756,282 connections, covering 98 per cent of people living in settlements.

These two bodies control rights over drilling wells and using water. Pumping and use of underground water usually require authorization from the MTOP-DNH, according to Article 3, Law Nº 17142, 14 July 1999. However, there are exceptions in the case of water for human drinking and hygiene needs, and drinking water for cattle. Applicants can request the right to use water and thus be registered in the Public Register of Waters (Article 8 onwards of the Code of Waters), generating rights before the Administration and third parties. Registering drilling with the DNH offers legal protection from future users who may want to make wells nearby or in the same fractures and area of influence, when these could interfere or deplete the flow due to overexploitation of the aquifer. This legal protection can even prevent drilling future wells in areas near registered wells

NEED LEGAL DETAILS ON AQUIFERS – SUPPOSED TO BE IN AN APPENDIX OF THE HYDROLOGICAL STUDY BUT NOT RECEIVED YET

Legislation relating to natural forests

Riverside forests (as well as other types of native forests) are protected by Law 15.939 and may not be exploited for commercial purposes, except in the ways provided for in Decrees 22/993 and 330/993 – relating to a special request filed previously before the General Directions of the Renewable Resources and Forestry of the Ministry of Cattle Production, Agriculture and Fishing, together with a management plan. The General Forestry Direction assesses the acceptability of the activity and the management plan, and may approve or not the request. Fire prevention rules also establish a protection strip of 20 metres between forestry plantations and the border of the native forest.

Legislation relating to mammals and birds

From the origins of the República Oriental del Uruguay, governments have drawn up a succession of laws and degrees relating to animals, starting from the Rural Code (Código Rural) of 1875 that elaborates norms about hunting. In addition, Uruguay is signatory to a variety of international treaties and codes that relate to the protection of animals. A list of the key pieces of legislation, many of which relate to either control of hunting or captive breeding, are outlined in Table 34.

Table 34: **Key articles of legislation relating to protection of wild animals**

Law	Details	Date	Details
Administration and Regulation about Native Fauna.	Law No. 9481	4 July 1935	Law relating to the exploitation of native species (including birds). People interested exploitation of a particular species have to present a proposal to the Commission of Fauna Protection
Convention for the Protection of Flora, Fauna and Natural Scenic Beauties	Law 13776	17 Oct 1969	Convention for the protection of flora, fauna and natural scenic beauties of American countries. In the different Appendixes the rights and duties of the signatories are described
Convention relating to Commerce of Threatened Species (CITES)	Law 14205	4 June 1974	Convention regarding commerce of wild fauna and flora threatened species. Species included in the Convention and Appendixes are listed
Greater rhea (R*hea Americana*)	Decree 483/79	1979	Relating to trade in feathers
Amendment to the CITES Convention	Law 15.626	11 Sep 1984	Amendment to the CITES convention of 1973
Greater Rhea – Feathers or feather duster – tenancy	Art. 10 Decree 254/85	1985	Owners of rhea breeding stations have to have proper identification
Wild fauna	Decree 693/87	9 Dec 1987	Creation of the Advisory Commission about native fauna and flora
Convention – Conservation of Wild Animal Migratory Species	Law 16062	6 Oct 1989	Species included in the convention are listed
Fierce or wild animals	Law 16088	11 Oct 1989	Regulation relating to captive wild animals, prohibiting keeping wild animals outside wild parks or zoos
Native fauna	Decree 655/91	1991	The decree 693/987 is modified, in reference to an honorary advisory commission on native flora and fauna
Chestnut-capped blackbird	Decree 475/91	1991	The Chestnut-capped Blackbird (*Agelaius ruficapillus*) is declared national pest
Hunting	Res. 393/96	8 May 1996	Relating to permission for hunting
Hunting	Decree 164/96	21 May 1996	Also about hunting permits, describes the species and times of free hunting
Hunting	Decree 165/96	21 May 1996	Sport hunting, permitted species and hunting seasons
Hunting	Decree 352/96		Regulates sport hunting derivates
Hunting	Decree 119/98	8 May 1998	Regulates hunting seasons and species
Hunting	Decree 126/99	1999	About hunting permits and transport of hunted animals including how many animals each hunter can transport
Red winged Tinamou (*Rhynchotus rufescens*)	Decree 416/01	24 Oct 2001	Protection of breeding places for Red-winged tinamou
Wild fauna	Decree 514/00	7 Jan 2002	Official list of wild fauna of Uruguay
Breeding native fauna	Decree 186/02	23 May 2002	Regulations controlling breeding of native fauna
Monk parakeet: control of species	Decree 343/02	30 Aug 2002	Regulation on the campaign to control the Monk Parakeet
Greater Rhea – Breeding industry	Decree 186/02	11 Feb 2004	Registration of establishments for the Greater Rhea breeding industry
Hunting	Res. 386/04	16 Dec 2004	Relating to sports hunting permit for non-resident people
Convention relating to the conservation of wetlands important for migratory birds (Ramsar)	Law 15337	2 Feb 1971	Relating to protection of internationally important wetlands and associated species

Legislation relating to insects

Uruguay does not have legislation indicating conservation measures for species of insects. The "Red Lists" from Rio Grande do Sul in Brazil (Fontana et al., 2003) may be used as a regional document (this is a regional list and not the same as the international Red List maintained by the Species Survival Commission for IUCN). The following protected species are listed in the orders Coleoptera and Lepidoptera.

Table 35: **Red List insect species in Brazil**

Species	Status in Brazil Red List
Coleoptera: Cerambycidae	
Plaumanniella novateutoniae Fisher, 1938	Threatened in the region and vulnerable in all Brazil
Quatiara luctuosa	Threatened, vulnerable in Rio Gde do Sul
Coleoptera: Chrysomelidae	
Anisobrotica donckieri	Threatened, vulnerable in Rio Gde do Sul
Doryphora reticulate	Threatened, vulnerable
Ensiforma caerulea	Threatened, in danger
Monocesta rubiginosa	Threatened, vulnerable
Schematiza aneurica	Threatened, vulnerable
Monocesta androgyna	There is not enough information and the records are very old. They may be considered in danger
Caraguata bella	
Caraguata tarsalis	
Chlorolochmaea paralella	
Lepidoptera	
Thysania agrippina	Threatened, in danger
Pterourus hellanichus	

Legislation relating to archaeology

Legislation related to the protection of national historical heritage is undergoing a process of change. Currently, a new law is being studied that would transform heritage management, in compliance with recommendations established by UNESCO over the last 20 years. It would be modelled on current legislation in Spain and Argentina. For archaeology, these modifications would raise levels of protection and caution. Therefore, it is recommended that Stora Enso focus on the proposed laws, in concordance with recommendations from UNESCO, ICOMOS and other bodies, even though they currently are not contemplated under national legislation.

The main current legislation includes law 14,040 (with corresponding decree 536/1972) and law 15,819 (decrees 618/86, 138/81, 419/91.) Departmental legislation also includes protection for prehistoric and historic heritage. The Department of Tacuarembó has led the way in developing protection resolutions for historic stone corrals, fences and narrowing chutes as well as stone pilings and Indian mounds. Detailed legal documents related to heritage protection are available in the working paper on archaeology. These were taken from the Heritage Commission web page (http://www.patrimoniouruguay.net) and the Bureaus of Culture of Tacuarembó and Durazno.

Section 3

Issues relating to sites and landscape

Methods used in the study

Planned activities

Landscape context

Mitigation management

Monitoring plan

Methods used in the study

Following the completion of the Environmental Management System in the middle of August, the following section will look at the planned activities at a landscape level, compare these with various norms (including the advice relating to IMS, the proposed rights based approaches and the proposed tools for managing at a landscape scale) and make an assessment of the likely impacts of the plantation project.

Landscape context

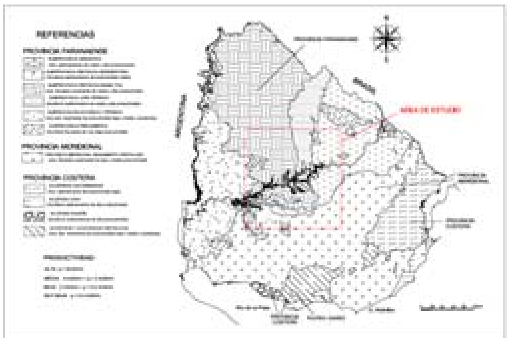
Note: do we need this section?

The following is a summary of earlier sections related specifically to the landscape context of the plantation.

The Landscape approach
The term "landscape" can be used to describe a "*Geographical construct that includes not only the biophysical components of an area but also social, political, psychological and other components of that system*" (Farina 2006). A landscape is not therefore the same as an ecosystem - the latter is a predominantly biophysical construct. However we note that the way in which the term "ecosystem" is now widely used – notably in the conservation based development of "Ecosystem Principles" – is for practical purposes synonymous with current usage of the term landscape. The rhetoric supporting large-scale approaches to conservation and development is now almost ubiquitous in project and programme descriptions. However, most approaches appear to be based mainly on spatial planning techniques, in which attempts are made to maximise the extent and connectivity of natural habitat and attempts to improve local livelihoods are confined to the residual land. In our use, the term "landscape" is a "*geographical construct that includes not only biophysical features of an area but also its cultural and institutional attributes*" (adapted from Farina 2006) (Sayer et al 2006).

The Landscape biophysical components
The Stora Enso plantation landscape as presently delineated is located in the centre of Uruguay, mainly southern Tacuarembó and practically all the department of Durazno along with parts of eastern Paysandú and Río Negro and small areas of northern Flores and northern Florida. This area includes some or all of four basins: Queguay, Tacuarembó, Merin Lagoon and most of the basin of Río Negro.

The area includes seven of the eleven landscape units defined for the Uruguayan territory: basaltic hill ranges, crystalline-metamorphic hill ranges, sedimentary and basaltic hillocks, sedimentary, crystalline and basaltic hills and hillocks, as well as lakes and lagoons. The study area includes part of the Hydrogeological Provinces Paranaense and Meridional. Both porous and fissured aquifers are found in the area. Each province is divided into sub-provinces, in accordance with the hydrogeological behaviour of the subsoil materials.



The different soil types in the plantation landscape are described, and for the purposes of analysis are ordered by means of two transects: crossing the department of Paysandú from west to east through the town Lorenzo Geyres and the department of Tacuarembó through the town of Clara; and the second crossing the department of Durazno from west to east from the Palmar Dam. (See Section 2)

The main soil types in the plantation landscape are outlined in the map in Figure 17 below.

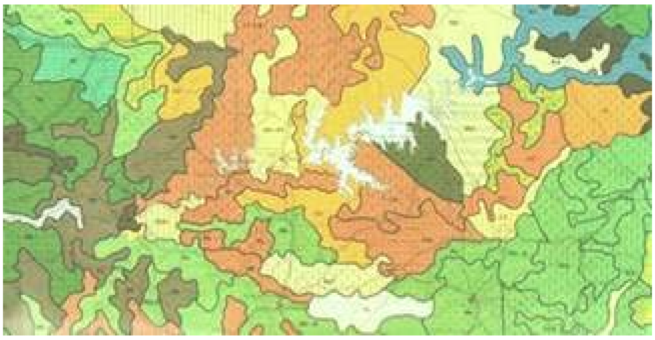


Figure 17: Map of the main soil types in the plantation landscape

Most of Uruguay is naturally dominated by scrub and grassland ecosystems, with much smaller areas of high forest and wetland.

The most recent phytogeographic research in Uruguay, Grela (2004) suggests two different floral regions based on the geographical distribution of the woody species. One is located in the western area along the Uruguay river (occidental flora) and the second covers the eastern and northeastern area (oriental flora) of Uruguay, with two disjunctive subregions (Tacuarembó-Rivera and Cerro Largo-Treinta y Tres-Lavalleja-Maldonado).

The following hotspots have been suggested for the Uruguayan arboreal flora (Grela, 2004). The most important *hotspots* of arboreal flora are not included in the study area defined by Stora Enso. However, this area of Uruguay is one of the least studied from a floral point of view and some of the typical species of areas of endemism may be detected in special types of vegetation present in the study area. Vegetation is highly associated with geology and geomorphology. A good interpretation of geological characteristics is therefore very helpful in understanding flora.

The Landscape socio-economic components

Uruguay is an increasingly urbanised population. The general conditions in the country are mirrored within the micro-region under consideration, with 88 per cent of the population living in the city (280,174 people) even in an area that is considered to be very rural. Paysandú contains most of the population (36 per cent), followed by Tacuarembó (29 per cent), Durazno (19 per cent) and Río Negro (17 per cent).

In the Plantation Landscape, 28 per cent of the population is under 14 years old, 61 per cent from 15 to 64 and the remaining 12 per cent is over 65, the percentage of children being considerably higher than for the country as a whole. In the rate of

attendance in primary and secondary school, analyzed according to age group, the rate is approximately 100 per cent for primary schooling in Durazno and Tacuarembó and 99 per cent in Paysandú and Río Negro. This rate is retained for the latter for secondary schooling, but drops considerably in the other provinces: 86 per cent in Durazno, 84 per cent in Paysandú and 91 per cent in Tacuarembó.
Although the land is almost completely dominated by crops and pasture, employment in this sector only affects a tenth of the population and many of these are family members who are not paid in a formal sense. The total rural area of the plantation landscape is 4,857,560 hectares which represents 99 per cent of the whole area. A total of 9,454 businesses were registered in the census and the agricultural population was estimated at 33,053 people (10 per cent of the total population registered in the 2004 Census).

Holdings tend to be reasonably large. The average number of hectares per holding of the region is 540 hectares, even higher in Río Negro and Paysandú, and in all cases higher than the average for the rest of the country. The large majority of the operations (82 per cent) are single person businesses, with 8 per cent joint venture and 9 per cent legal partnerships. Regarding the nationality of producers, 96 per cent of agricultural businesses belong to citizens of Uruguay, representing 90 per cent of the surface. Around 29 per cent of agricultural and livestock holdings have access by using a permanent road or route, 46 per cent use improved roads and 26 per cent by earth road.

Mitigation management

Note
This section will also be written after the IMS is complete in August

Monitoring plan

Measuring landscape performance

"Landscape" and "ecosystem" approaches are replacing "Integrated Conservation and Development" as the predominant organising frameworks for the field activities of many conservation agencies. Many field interventions in developing countries now operate at large spatial scales and deal with complex land cover mosaics. They frequently aspire both to improve local livelihoods and conserve the environment. However, there is little empirical evidence about the effectiveness of these approaches. Monitoring and evaluation methods typically emphasise either the state of species (or ecosystems), or simply project deliverables and outputs (Stem et al 2005). The approaches used often have limited ability to address the issue of where the balance between conservation and development (improvement of livelihoods) should lie. Methods are needed to make the tradeoffs between conservation and development explicit, and to provide platforms for negotiation about these tradeoffs. Tough questions need to be tackled. These processes should be founded on some form of objective landscape performance monitoring.

Considering this it is proposed that the Stora Enso Monitoring plan could be based on two modules:

1. The Ecosystem Integrity Monitoring Toolkit;

2. The Landscape Outcome Assessment Methodology;

The Ecosystem Integrity Monitoring Toolkit

This tool identifies a series of indicators for monitoring the project progress and its long term impacts, positive and negative, on the environment. A series of specialists in the fields of geology, hydrology, soils, botany (trees, wetlands and grasses), mammals, birds, reptiles and amphibians and insects and archaeology were all commissioned to provide background information about the region but also to help develop indicators. The indicators are presented below, in Table 36.

Table 36: **Indicators for monitoring**

Thematic area	Indicator	Method	Intensity
Geology	Potentiometric levels	Observation wheels	Annual
	Chemical parameters	Observation wheels	Annual
Soils	Physical parameters	Field sample	Adaptative
	Chemical parameters	Field sample	Adaptative
	Biological parameters	Field sample	Adaptative
Vegetation	Invasive species	Mapping distribution	All land holdings
	Native habitats	Conservation status	High conservation value areas
Fauna	Ecosystem integrity (benthonic, coleopteran, amphibian, reptile, birds, mammals)	Conservation status	High conservation value areas

More detailed information is provided in Section 4. The draft list of indicators was drawn up in a workshop in Montevideo in April 2007; it has still to be finalised.

The Landscape Outcome Assessment Methodology

LOAM is an approach to assess the environmental outcomes and changes in peoples' livelihoods resulting from landscape-scale conservation interventions. It is based on simple sets of performance indicators developed through participatory processes that included a variety of stakeholders. This selection of indicators is designed to reflect wider landscape processes, conservation objectives and as local people's preferred scenarios. This framework, combined with the use of social learning techniques, helped stakeholders develops greater understandings of landscape system dynamics and the linkages between livelihood and conservation objectives.

Large scale conservation and development interventions should use these approaches to explore linkages and improve shared understanding of tradeoffs and synergies between livelihood and conservation initiatives. Such approaches provide the basis for negotiating and measuring the outcomes of conservation initiatives and for adapting these to changing perspectives and circumstances (Sayer 2006).

The Stora Enso workshop achieved good consensus on a first indicator set (see table below). However it is more likely that the framework produced will only be partially complete. In addition the latest data for a specific indicator may not be immediately available, or in the most extreme case may need to be collected. Therefore it is best to plan for the time of a post-workshop follow-up to complete the indicator set, gather and/or collect the required data and compile the first baseline assessment. This process in itself will provide a first feasibility test of the proposed indicator set.

Table 37: **First suggestions for an indicator set to apply the LOAM**

Thematic area	Indicator	Method	Intensity
Anthropology	Human assets (health, education)	Landscape Outcome Assessment Methodology (LOAM)	Sample of representative villages
	Social assets (services, jobs)		
	Economic assets (economy status)		
	Political assets (local policies, stakeholders)		
	Environmental assets (environmental problems)		

More detailed information is provided in Section 4.

Section 4
Tools

Rights based development

Site selection and planning toolkit

Monitoring ecosystem integrity

Forest suitability map

Landscape planning within a plantation

Landscape Outcome Assessment Methodology

High Conservation Values

"*The United Nations does not ask or expect business to assume the responsibilities of government. It does ask business to act in a responsible way in their sphere of activities*"
Mary Robinson, UN High Commissioner for Human Rights (2001)

Overview

"Human rights are becoming a bottom-line business issue. A corporate commitment to upholding international standards can bring benefits to companies and society at large."

"*Human rights are becoming a bottom-line business issue. A corporate commitment to upholding international standards can bring benefits to companies and society at large*" (Frankental and House 2000). This statement reflects a growing trend in international business, civil society, and governmental sectors of integrating human rights considerations into practice, or taking a "human rights approach" (HRA). The following section provides a brief overview of what HRAs are, reasons Stora Enso might consider adopting such an approach, and some suggested guidelines and tools Stora Enso might look to in developing an HRA to plantation establishment and management.

Understanding business's roles and interests in human rights approaches

Human rights are universal, interdependent, indivisible entitlements necessary for dignified living; they belong to each and every person by virtue of her or his being human. While these inherent rights exist independent of their legal recognition, protection under international law is an important source of human rights' power. Central to the many legal instruments protecting human rights are the Universal Declaration of Human Rights[2] and the core United Nations treaties supporting it[3]. These instruments cover:

- ✓ **Substantive rights** such as life, health, food, housing, and just and favourable work conditions;
- ✓ **Procedural rights** such as participation in political affairs, information, and access to justice; and
- ✓ **Cross cutting principles** including protection from all forms of discrimination (Hausserman 1998)

All human beings are rights holders. The individuals and groups responsible for realization of their rights are duty-bearers. The obligations of States – the traditional and primary duty-bearers in the human rights framework - include:

- ✓ **Respecting rights***:* refrain from taking actions that infringe on people's enjoyment of their rights;
- ✓ **Protecting rights***:* ensure that third parties (e.g., private individuals, businesses, non-governmental organizations (NGOs), etc.) do not infringe on people's rights; and
- ✓ **Fulfilling rights***:* develop an enabling environment (through legislation, budgetary policy, public policies, etc) in which people can fulfil their own rights, and provide services to more directly fulfil rights when people are not able to do so for themselves (based on UNDP 2000 and Amnesty International 2005).

[2] www.unhchr.ch/udhr/lang/eng.pdf
[3] These include the International Covenant on Civil and Political Rights (http://www.ohchr.org/english/law/ccpr.htm) and the International Covenant on Economic, Social and Cultural Rights (http://www.unhchr.ch/html/menu3/b/a_cescr.htm)

States remain the primary duty-bearers. However, the international community is realizing that, given ever increasing globalization and the accompanying increase non-state actors' power (including transnational corporations and NGOs), it is important for non-state actors (i.e., "third parties") to recognize *their* responsibilities towards human rights. The nature and scope of third-party responsibility remains ambiguous[4]. It is derived in part from the State's obligation to protect. However, where the State does not or cannot fulfil its obligations, third parties are not absolved of all responsibility (Junck 2001b, International Council in Human Rights Policy 2002, Ziegler 2003 and Clapham 2006). An important distinction between state and non-state responsibility may be that non-state actors have primarily negative responsibilities – that is, to respect or refrain from undermining rights – while states have additional obligations to take positive actions to fulfil rights. However, Jungk (2001b) suggest that, within certain spheres, including workplace standards, businesses also have positive obligations.

HRAs, generally speaking, establish processes and generate outcomes that are consistent with human rights norms and principles. Such approaches are emerging in the work of states, development organizations, conservation organizations, and the private sector, in large part in response to a growing realization that *all* sectors impact rights and that, as described above, responsibilities are widespread. There are various specific uses of the term "human rights approach", which change based on the actors' perspective and context. In fact, 'HRA' appears to be rarely used in the business sector, which instead uses terms like "human rights compliant practice". The general concepts, however, are similar. At a minimum, an HRA requires that human rights principles and standards be respected (not violated). In more comprehensive HRAs (usually in context of development NGOs) rights fulfilment may be the primary objective[5].

Reasons transnational businesses, including Stora Enso, might consider adopting an HRA include:

- ✓ Recognition that economic development can have positive and/or negative human rights impacts
- ✓ Realization that the human rights framework, reflecting internationally agreed norms, can provide clarity regarding the responsibilities actors may have for the impacts of their work[6]
- ✓ Recognition of the well documented risks that businesses increasingly face by *not* understanding and taking proactive measures to mitigate their human rights related impacts (note that Wilson and Gribben (2000) find that, of the biggest 500 companies, 36 per cent have abandoned a proposed investment project, and 19 per cent have disinvested from a country, due to human rights issues) and, conversely, recognition of the benefits of being a human rights compliant business (see box overleaf)
- ✓ Response to the increasing expectations on businesses reflected in UN and OECD guidelines, including the UN's controversial draft 'Norms on the

[4] For instance, business engagement with human rights, where not specifically mandated by state laws, has long been seen as voluntary. However, with introduction of the UN Draft Norms (see 14), some recent legal developments through which businesses may be viewed as directly and legally accountable (see OHCHR 2000, Sec.III), and other trends (see Clapham 2006), understanding of the extent to which business engagement is voluntary appears to be changing
[5] See, for instance, the rights based work within ActionAid, Care, Oxfam, and Save the Children
[6] See http://www.unhchr.ch/development/approaches-07.html for general discussion

Responsibilities of Transnational Corporations and Other Business Enterprises with regard to Human Rights[7], and the related trend in the international business community of adopting voluntary norms based on human rights, sometimes in partnerships with NGOs[8]

✓ Recognition that engaging with people and respecting their rights should be done because they are *rights holders* and that, therefore, others have corresponding duties

Despite many advantages, there are challenges Stora Enso should be aware of in deciding on whether or not and how to adopt an HRA to plantation development and management. HRA to business practice is an emerging field and there is no consensus regarding the nature and scope of responsibilities, particularly as businesses expand to countries without sufficient national institutions for human rights protection. Further, it is not always clear how human rights protections can be effectively operationalized given unique sectoral and contextual considerations and the limits of the company's actual sphere of influence. For instance, where there are pre-existing conflicts over land that Stora Enso may buy or use, efforts to understand and effectively respond to the range of associated rights issues will be challenging. Finally, Stora Enso may face unique challenges because most HRA tools developed to date focus on the extractive industry, and therefore may have to be adapted to the plantation context. *For the same reason, however, Stora Enso has an opportunity to act and be seen as a leader in the sector*.

Potential Advantages for Company in Adopting Human Rights-Based Practice (Adapted from Amis et al 2005)

- Protect reputation and image – be viewed as leader
- Establish and maintain competitive advantage
- Improve staff recruitment, retention and loyalty
- Enhance productivity
- Retain your license to operate
- Reduce [longer run] cost burdens
- Benefit from active [rights-holder and] stakeholder engagement
- Meet investor expectations [thereby also attracting potential new investors]

Suggestions on developing an HRA for plantation development and management

Stora Enso may adopt a variety of measures for addressing human rights. The continuum below provides one way of thinking about the range of possibilities - from avoiding rights violations, to, with respect to employees and people whose livelihoods are linked with plantation land, taking actions to actively promote and enhance rights.

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[7] The UN 'Draft Norms' are available at www.unhchr.ch/Huridocda/Huridoca.nsf/0/64155e7e8141b38cc1256d63002c55e8?Opendocument
Other relevant guidance includes: UN Global Compact (www.unglobalcompact.org/) and OECD Guidelines for Multinational Enterprises (www.oecd.org/daf/investment/guidelines)

[8] See, for example: Business Leaders Initiative on Human Rights (www.blihr.org); Prince of Wales International Business Leaders Forum (www.iblf.org); Business for Social Responsibility (www.bsr.org); Amnesty International UK Business Network (www.amnesty.org.uk)

RESPECT (do no harm / avoid violations /act as responsible third party)	PROTECT (ensure against violations arising from supply chain)	FULFIL / FACILITATE (take steps to enhance peoples rights within your sphere of influence)

←MIN---------- LEVEL OF ENGAGEMENT with HUMAN RIGHTS ----------MAX→

Figure 18: **Level of engagement with human rights**

Much literature on human rights and business suggests an approach covering at least the first two levels – ensuring against violations arising directly from company practice and indirectly from the supply chain (See, among others, Frankental and House 2000; Jungk 2001b; and Amis et al 2005). At this level of human rights engagement, HRA goals might include those outlined below (adapted from Amis et al 2005, Danish Institute for Human Rights 2006).

With respect to potentially impacted communities…

✓ Avoid population displacement, defined as either physical relocation or reduced access to key resources (see Cernea 2006). Where no other options exist, refer to International Labour Organization (ILO) guidelines on seeking the free, prior, and informed consent of communities, particularly with indigenous peoples ILO Convention 169.

✓ Ensure respect for customary institutions and norms valued by the relevant communities

✓ Avoid harm to (or increase) access to and availability of essential resources for those living on lands impacted by the plantation. Remember that a plantation's impacts may be relatively far reaching, e.g., reduced access to regional ground water due to increased use for the plantation See International Covenant on Economic, Social, and Cultural Rights (1966) for this and the previous point

✓ Ensure that security arrangements are consistent with human rights to security of person, free assembly, free speech, and other relevant rights.

✓ Support potentially impacted people's rights to information about (potential) impacts of the plantation See International Covenant on Civil and Political Rights (1966) for this and the previous point.

✓ Take action within the scope of the business's power to engage with claims holders and duty bearers to promote further realization of human rights.

With respect to employees and workplace practices…

✓ Ensure rights compliance in workplace conditions, including labour rules and health conditions (consider ILO Convention No. 155 on Occupational Health and Safety, and No. 131 on Minimum Wage Fixing).

✓ Guarantee that labour is not forced (consider ILO Convention No. 29 on Forced Labour and ILO Convention No. 105 Concerning the Abolition of Forced Labour).

- ✓ Ensure against all forms of discrimination, e.g., gender, racial, or religious (consider ILO Convention No. 111 concerning Discrimination [Employment and Occupation]).

- ✓ Guarantee freedom of association by allowing trade unions and respecting people(s)' rights to assemble and engage in political participation (consider ILO Convention No. 98 concerning the Right to Organize and Collective Bargaining, and ILO Convention No. 87 concerning Freedom of Association and Protection of the Right to Organize)

- ✓ Avoid child labour[9].

….But how can these objectives be operationalized?

Ultimately, any company will need to establish a set of processes appropriate for their sector and context. Key steps for this can be drawn from experience in other companies, and from human rights, environmental, social and health impact assessments. One possible set of steps is summarized here (adapted generally from several sources, including Amis 2005, Danish Institute for Human Rights 2006, Human Rights Impact Organisation etc). A review of existing tools to support each step is provided in the final section.

1. *Share Information*
   Share with local communities and other interested parties, in appropriate and effective ways, truthful and reasonably complete information about the business's plans and operations, and their potential impacts. Continue information sharing throughout the process
2. *Understand Concerns*
   Consult broadly with local communities, NGOs, relevant government bodies, and other relevant parties to determine their concerns and expectations about the plantation's impacts (including those arising from the supply chain).
3. *Identify Likely Risks and Contributions*
   Use consultative processes to identify what rights issues the company is at risk of impacting. The company should consider, *inter alia*: risks associated with the general political, policy and social context; economic risks including decreasing livelihood opportunities and job choice; risks associated with *acquiring land* for plantation establishment or expansion; and risks associated with *land use*, e.g., altering water flows and availability in the region. Regarding land acquisition, we recommend considering both legal and *customary* land and resource use/tenure, including by any mobile or semi-mobile communities. In addition to potentially negative impacts, the company should consider where and how its operations may make a *positive* contribution to human rights realization.
4. *Recognize Capabilities and Limitations*
   Before responding to any potential impacts, the company should understand the nature and degree of its relationship to the human rights situation: Are the human rights impacts direct or indirect? What can the company do within its sphere of influence? What *can't* it do?
5. *Negotiate Mitigation Mechanisms*
   Engage local communities and other relevant actors in analyzing risks and possibilities, and in devising alternatives and/or mitigation and compensation measures. Negotiate mutually satisfactory measures. Options include

[9] This goal is complicated by the fact that, in some cases, eliminating all child labor can have adverse impacts on families. For guidance consider the UN Convention on the Rights of the Child, ILO Convention No. 182 and ILO Recommendation No. 190, on The Worst Forms of Child Labour, and ILO Convention No. 138 concerning Minimum Age. See also generally for this section ILO Declaration concerning Fundamental Human Rights at Work

establishing citizens' advisory councils (CAC) for major operations, and dispute resolution procedures.

6. *Assign Responsibility and Learn by Doing*
   Assign management responsibility (see Wilson and Gribben 2002) and devise implementation procedures for the agreed upon mechanisms. Communicate these decisions widely within the company and the interested public.
7. *Monitor and Evaluate*
   Monitor impacts, evaluate them against desired outcomes, and adjust the approach as necessary. Use third party verification and consider reporting outcomes using Global Reporting Initiative's (GRI) standards or other widely used standards that provide a basis for comparison.
8. *Establish More Permanent Policies*
   On the basis of lessons learned in practice, establish company wide policies for addressing human rights and make these policies publicly available. Continue monitoring, evaluation, and on-going adjustments as appropriate once policies are in place.

Some existing mechanisms & tools to support HRA to plantation development

The following are a selection of many that are available, chosen on the basis of their likely usefulness to Stora Enso.

- ✓ *Mechanisms for on-going rights-holder and stakeholder engagement:* CACs are a mechanism to ensure participation by informed rights-holders and stakeholders in major company operations which may impact their rights. CACs are typically on-going – that is, not set up solely for the HRIA process - and require independence, funding, and access to information. CACs are typically given advisory powers (for more detailed information on CACs, including their potential benefits for the company, (http://www.iucn.org/themes/ceesp/seaprise.htm#council)

- ✓ *Human Rights Impact Assessments (HRIA):* The Humanist Committee on Human Rights provides HRIA instructions and links to case studies and tools for each step, including monitoring and evaluation (http://www.humanrightsimpact.org/about-the-hrirc/). The International Business Leaders Forum will soon release a comprehensive HRIA guide specifically for businesses (http://www.iblf.org/activities/Business_Standards/Human_Rights.jsp).

- ✓ *Human Rights Compliance Assessments (HRCA)*: The Human Rights Business Project's (HRBP) HRCA is a widely tested diagnostic tool with over 300 questions and over 1000 guiding indicators, broken down by right and by considerations of workplace practice, community impact, and supply chain management (http://www.iblf.org/activities/Business_Standards/Human_Rights.jsp).

- ✓ *Risk identification and evaluation tools*: To understand risks associated with the broader political and social context, and decide how to respond, companies may consult IBLF Country Risk Assessment Maps (http://www.iblf.org/resources/general.jsp?id=69), HRBP Country Risk Reports (http://www.humanrightsbusiness.org/070_country_risk.htm), and other country risk reports. The HRBP also offers a general conceptual model for deciding whether or not to operate in countries where human active violations are occurring (Junck 2001a).

- ✓ *'Code of Conduct' reviews*: HRBP provides a Code of Conduct human rights compliance review service (http://www.humanrightsbusiness.org/060_consultancy_services.htm). Amnesty International provides a general company Code of Conduct checklist (www.amnestyusa.org/business/checklist.html).

- ✓ *Other services and general sources*: HRBP offers business training courses, a human rights hotline, and a NGO partnership service (details at: http://www.humanrightsbusiness.org/060_consultancy_services.htm). There are also several research organizations and information clearing houses that specialize in business and human rights issues. These can be consulted for general information, or as specific questions arise (see for instance http://www.business-humanrights.org/Home) and (http://www.ashridge.org.uk/Website/Content.nsf/wFARACB/Ashridge+Centre+for+Business+and+Society?opendocument)

Conclusion

Global attention on business's human rights impacts is growing. In an era of ever increasing information flow, transnational corporations' reputations and license to operate are likely to be increasingly affected by this trend. New expectations and demands for business to take responsibility for human rights impacts, even in the absence of national laws, present serious challenges. However, they also present opportunities for companies like Stora Enso to identify themselves as leaders in responsible practice. Adopting a human rights approach to plantation establishment and management is one way to take and benefit from such a leadership role.

Tools for planning and managing plantations: use of indicators

Although the term biodiversity refers to ecosystems, species and genetic variation, the number of species is the measurement most frequently used as it represents one of the easiest elements to measure at different geographical scales. It is well known that that the spatial structure at landscape level has effects upon the species richness, abundance and interactions among species in ecosystems, and therefore number of species is a common measure used to identify conservation priority areas.

With respect to biodiversity, indicators are used in two main ways. The first is their use in measuring environmental change or more specifically anthropogenic influence on natural communities and their second is the use of specific indicator groups to estimate the biological richness of a specific area. In the latter, the term ***bioindicator*** is applied in the context of the emerging discipline of "biodiversity indicators". Particular indicator species or groups are selected for measurement because of their ability to provide information on the total diversity of the species, and therefore, on the total diversity of the place of interest. It is assumed that the patterns of diversity, rareness, etc., of these groups are ***indicators*** of similar patterns in the rest of the organisms in the area. The main difficulty on using indicator taxons to estimate the biodiversity of a place resides in the selection of the right group. Choosing an indicator that both provides a rich enough source of information and is also possible to use without incurring excessive cost is tricky. In an ideal world, indicators would have as many as possible of the following attributes (based on Pearson 1994, Halffter et al 2001, Dudley and Jeanrenaud 1997 and discussions during the indicator workshop):

Workshop to choose indicators for the Stora Enso plantation project in Uruguay

- ✓ Well-known and stable taxonomy: species groups that are well understood and, for instance, where taxonomists are not still making fairly frequent additions or changes
- ✓ Well known natural history: so that there are not liable to be surprises such as the species appearing in completely unexpected locations or conditions
- ✓ Response patterns reflected in other species: so that for instance a decline in the indicator species is likely to indicate a more general decline in the health of the ecosystem
- ✓ Easy to observe and manipulate
- ✓ Easy to identify: so that ideally indicators can be used by people with only moderate levels of training rather than relying entirely on specialists
- ✓ Habitat specific
- ✓ Good knowledge of distribution: ideally indicators will be well studied and there should already be a database of information about where they are found so that a good baseline of information can be established
- ✓ Available most or all of the year: allowing surveys to take place at any time
- ✓ Provide added value: i.e. tell something that cannot be detected in any other way (some indicators are driven by the interests of specialists rather than necessarily being the easiest way of collecting data about a habitat)
- ✓ Make sense to people: particularly where indicators are being used in a transparent reporting framework, as will be the case here, they will be much easier to gain acceptance for if they are "sympathetic" to most people – i.e. this tends to act against obscure or hard-to-measure species that will only be known to specialists

Finding something that fulfils all of these needs is probably impossible! But a good indicator should meet many of the above.

Developing a toolkit for site selection and planning

With respect to **site selection and planning**, Stora Enso needs several pieces of information:

- ✓ Information about social conditions to ensure that the plantations play a positive rather than a negative role in development
- ✓ Details of areas where conditions make it more or less suitable for planting
- ✓ Information about the natural and cultural values of proposed areas to avoid causing damage to biodiversity, environment and historical legacy

A series of detailed stakeholder interviews have helped to identify hopes and fears about a new plantations and socio-economic studies have also identified the most suitable areas for development in terms of job availability and workforce.

With regard to location, issues of soil quality are important: both to locate the most suitable soils but also to avoid those that may not be best for tree growth – for instance areas with high calcium content. The consultants cautioned against buying areas with valuable mineral deposits because the government has the power to purchase those sites to foster exploitation. And hydrology is also very important, particularly in terms of providing information about areas where plantations could upset water balance in surface or ground water.

If Stora-Enso wants to take conservation seriously in Uruguay, then it needs to look at grasslands. Natural woodlands including riparian woodlands, wetlands and native palm communities are all protected by law – not perfectly but at least well enough that an international company will be expected to protect any remnants in its lands. Stora Enso has already stated informally that it will protect any inland sand-dunes on its property (these are not particularly suitable for tree planting in any case). The grassland or campos is by far the most common habitat in Uruguay, also to some extent the most unique and certainly the least protected. While we have not come across any grassland that has not been affected by past management, it is clear that its value to conservation varies dramatically with geography, soil type and most important of all with previous management history. Permanent pasture that has not been fertilised and never been ploughed for crops is by far the most valuable, but there are many different degrees of value below this. The challenge for Stora Enso is that the differences in value are not always immediately obvious to a non-expert, and it is clearly impractical to send an expert botanist on every site inspection. For this reason we wanted to develop a simple toolkit to help trained non-specialists – in this case probably the forest engineers who make the first inspection of a site – to make an instant judgement about the value of any grassland from a conservation perspective. A second aim is for the toolkit to be used more systematically within a plantation site during the planning process to help identify the most valuable areas that might be set aside, or used as corridors or buffer zones.

An initial attempt at mapping Valuable Grassland Areas in the campos and pampas regions of South America has already been undertaken by Fundacion Vida Silvestre in Buenos Aires, Argentina. However the scale of mapping was quite coarse and the areas were identified by expert opinion (including by one of the consultants in the current project). Whilst very useful in general terms, the mapping is not detailed enough to help with individual site selection and in any case the area under consideration, being less well surveyed than many others, is likely to have been under-reported.

It was therefore decided to identify a series of indicators – species or habitats – that could help provide a tool for site selection and planning. It was hoped that at least some of these indicators would also be useful as a means of monitoring progress with the project and its long term impacts, positive and negative, on environment and society.

A series of specialists in the fields of geology, hydrology, soils, botany, mammals, birds, reptiles and amphibians and insects, archaeology, social conditions and anthropology were commissioned to provide background information and used to help identify indicators….

It is acknowledged that indicators can never be perfect – particularly in the current situation where so much remains to be recorded and discovered. But we believe that they nonetheless provide the best way of informing management decisions in the absence of complete survey information.

A series of specialists in the fields of geology, hydrology, soils, botany (trees, wetlands and grasses), mammals, birds, reptiles and amphibians and insects, archaeology, social conditions and anthropology were all commissioned to provide background information about the region but also to help develop indicators – initial thoughts are described in section 2 above. The same experts were used to help identify indicators. A four stage process was used:

Initial workshop to introduce the ideas and agree the format
↓
Research by individual consultants or small groups to develop landscape characterisation papers on the key topics including proposals for possible indicators from the various disciplines
↓
Second workshop to present results and work collaboratively to develop indicators:
For site selection and planning
For monitoring
↓
Consolidation phase to agree a final set of indicators and produce visual tools

The first workshop took place in January 2007 in Durazno, followed by a two month period in which the landscape characterisation papers were produced and then a second workshop in early April in Montevideo. At the second workshop experts worked in specialist groups (zoology, botany and geography, social and historical) then all together in plenary to brainstorm indicators and agree collectively what would be most suitable. This was a collaborative, cross-disciplinary effort. At the meeting it was also agreed that a "toolkit" for site selection could usefully include the following:

- ✓ A **suitability map** summarising information on soil, geology and hydrology, social information
- ✓ An **illustrated key** to help distinguish
    - Different quality of grassland
    - Habitats rich in animal life
    - Likely archaeological sites and artefacts
- ✓ A **digital camera** so that surveyors can record key information for experts
- ✓ A standardised **report sheet** for recording field data and photographs

Taken together, the tools provide a simple kit for site selection that should both help save time for the company and avoid causing unnecessary damage to the cultural or biological heritage of Uruguay.

The planning tools therefore draw on both existing information and information to be collected by field staff, summarised in Tables 38 and 39 below:

Table 38: **Indicators for site selection drawing on existing information**

Thematic area	Indicator	Source	Recommendation type
Geology	Aquifers recharge areas	Hydrogeology map (SIG)	Planning
Soils	Soil map	Map CONEAT	Site selection
Vegetation	Site agricultural history	Aerial photography	Site selection
Archaeology	Archaeological sites	Archaeological map (SIG)	Planning

The four layers can be integrated into a suitability map to help choose the best general areas to focus on for site selection. Information on aquifer recharge areas is not precise. It will indicate those areas that are relatively trouble free and those where recharge may be an issue – in the latter case further research will be needed.

Table 39: **Indicators for site selection drawing on field information**

Thematic area	Indicator	Source	Recommendation type
Geology	Limiting features: hard rocks, basalts, calcium carbonate	Field observation (photo)	Site selection
Soils	Soil texture and depth	Field sample	Site selection
Vegetation	Identification of Virgin Campos and Palms	Field observation (photo)	Planning
Fauna	Campos birds	Field observation (counting)	Site selection
Archaeology	Archaeological sites	Field information (question & photo)	Planning

The field visit should be supported by a field sheet with photos, identification notes and a standardised recording sheet for record information. It is suggested that this information is added to the reporting sheet already used by Stora Enso, which is currently being revised. A simple protocol will be needed to ensure that information is collected in a standardised and useful way.

The list above is a minimum data set. Stora Enso staff indicated that they wanted to include several other items of information, such as presence of woodland and wetland, because the proportions of these would also help to determine whether or not the site is suitable for purchase and would also need to be included in all planning. Table 40 below gives a slightly expanded list of indicators, with more details of what each would entail.

An initial set of indicators have been chosen for monitoring progress.

Table 40: **Details of proposed indicators for site selection and planning**

Indicator	**Methodology used**	**Notes**
Soils, geology and hydrology		
Information presented in the form of a suitability map to help identify areas worth further investigation and areas to avoid		
Soils		
Suitability for trees	CONEAT national map of soils	Publicly available information
Texture	Standard typology including e.g. clay content	
Depth (for roots)	Depth of bedrock	
Geology		
Surface rock	Aerial photographs (?)	Not suitable for planting
Basalt	Existing information	High calcium sub-optimal for trees
Potential mining areas	Existing information	Risk of compulsory purchase
Hydrology		
Aquifers		
✓ Free	Aerial photographs	
✓ Confined and semi-confined	Need field studies	
✓ Recharge areas	Data already available	Need to set a baseline
Biodiversity		
Vegetation		
Agricultural history	Aerial photography	
Information below presented as illustrated keys		
Quality of grassland		
✓ Natural grassland	Presence of indicator species	No crops for at least 3 years
✓ Virgin grassland	Presence of indicator species	Never cropped
✓ Former cropland	Presence of indicator species	
Palms	Presence of palm species	
Woodland	Presence of native woodland	
✓ River woodland	Presence of river woodland	Restoration could be useful
Wetlands	Presence of wetlands and flooded areas	
Mobile dunes	Presence of dunes	
Rocky outcrops	Presence of rock outcrops and cacti	Need to determine if rocky outcrops are ever planted?
Fauna		
Main identification as an illustrated key of birds with extra information on rare and some seasonal species		
Birds		
✓ Abundance	Qualitative information about numbers	
✓ Habitat quality	Presence of indicator species	
Rare species	Presence recorded	
Seasonal species	Information on good seasonal indicators	
Archaeology		
Known sites	Using existing GIS data	
Information below presented as an illustrated key		
Key relics	Important relic species that may be found	
Key sites	Rock outcrops etc	

Developing a toolkit for monitoring ecosystem integrity

Note: does having 2 tables make things confusing? Should we conflate?

The workshop also identified a series of potential indicators for planning. These were less thoroughly developed, because the process of planning and implementing an assessment methodology is planned as a later stage in the project, but the initial list will be useful both in planning a participatory assessment but also in identifying indicators for the project. These are presented below, first in summary conceptual form and then in more detail, in Tables 41 and 42.

Table 41: **Indicators for monitoring**

Thematic area	Indicator	Method	Intensity
Geology	Potentiometric levels	Observation wheels	Annual
	Chemical parameters	Observation wheels	Annual
Soils	Physical parameters	Field sample	Adaptative
	Chemical parameters	Field sample	Adaptative
	Biological parameters	Field sample	Adaptative
Vegetation	Invasive species	Mapping distribution	All land holdings
	Native habitats	Conservation status	High conservation value areas
Fauna	Ecosystem integrity (benthonic, coleopteran, amphibian, reptile, birds, mammals)	Conservation status	High conservation value areas
Anthropology	Human assets (health, education)	Landscape Outcome Assessment Methodology (LOAM)	Sample of representative villages
	Social assets (services, jobs)		
	Economic (economy status)		
	Political (local policies, stakeholders)		
	Environmental assets (environmental problems)		

Table 42: **Detailed proposals for monitoring and evaluation indicators**

Indicator	Method used	Frequency of collection	Notes
Soils			
Visual monitoring as part of standard field surveys			
Physical	Recording signs of a hard layer of topsoil developing	Annually in erosion-prone areas, less frequently elsewhere	
Chemical	Recording loss of colour		Indicates loss of organic matter
Biological	Recording signs of soil life		
Sampling and analysis (usually only needed if visual survey suggests that there are problems)			
Physical	Structural analysis	Annually in erosion-prone areas, less frequently elsewhere	
Chemical	Nutrient availability and cation exchange capacity		For example borium
Biological	Analysis of soil organisms in sample		

Indicator	Method used	Frequency of collection	Notes
Hydrology			
Rate of aquifer recharge	Comparing (for both open and fractured aquifers) ✓ Rate of recharge over time ✓ Recharge in planted and unplanted areas	Annually	
Water quality	Use of surveillance wells to monitor changes in water quality		
River quality	Nothing suggested		
Lake / reservoir quality	Nothing suggested		
Vegetation			
Invasive species	Monitoring of all sites for the presence of invasive species		Need an identification key for survey teams (?) and to establish a baseline
High conservation value (HCV) areas	Regular monitoring of changes to flora and fauna in representative sites		Need to agree number of HCV sites and details of monitoring
Fauna			
Changes in HCV areas		Annual monitoring plan	
✓ Aquatic communities	Monitoring of benthnic communities and amphibians		
✓ Terrestrial communities	Monitoring of beetles, reptiles, birds, mammals	Detailed proposals exist	
Archaeology			
Dry-stone structures etc	Monitoring of condition of important cultural sites		Most covered by law
Social conditions			
Human	Health, education, training, internet access, migration		
Social	Cultural dynamics, stakeholder opinions		Cultural indicators to be identified
Financial	Employment (existing and forestry-related)		
Physical	Housing quality, shops, etc (existing and new)		
Natural	Impacts on water, fire, erosion		Stakeholder opinions and data

Forest suitability map

This is currently being developed

Landscape planning within a plantation

Background

A landscape approach to forest management has been defined as "***a balanced mixture of protection, management and restoration providing biodiversity, ecological, economic and social benefits and resisting detrimental change"*** Aldrich et al 2003). The precise balance between the three will vary depending on the state of the landscape and the priorities for goods and services: for instance an area of irreplaceable old-growth forest might be expected to have a relatively high proportion of protection while the managers of an area of secondary forest might put more emphasis on management or restoration. But the overall principle of **management of a balanced mosaic of different end uses at a landscape scale** remains the same.

The approach does not imply that any particular landscape can be represented by one "ideal" mosaic which, once achieved, should remain static indefinitely, Rather in almost all cases there are a range of possible ways of managing the landscape, of which a number of the "best" can, if implemented effectively, help to provide the variety of functions required from the landscape. The philosophy driving this approach recognises that management to maximise the economic values within a landscape needs to be balanced with consideration of issues such as biodiversity conservation and human wellbeing to meet sustainable development targets and that this will inevitably entail negotiations and trade-offs.

The approach recognises that conditions vary between regions and stresses a flexible framework. It draws on, and is a practical application of, the *Ecosystem Principles* agreed by the Convention on Biological Diversity (CBD 2004). The belief that it is possible to integrate forest management with the protection and in some cases restoration of wider ecosystem and social values is based on a number of assumptions including in particular:

- ✓ **Synergy**: an integrated approach to management will give greater net benefits than those achieved by pursuing these aims separately
- ✓ **Trade-offs**: within a landscape context, it is possible to reach a management outcome that meets different needs and achieves a range of environmental and socio-economic goods and services
- ✓ **Cost efficiency**: integrating programmes of protection, management and restoration will allow more efficient use of financial and staff resources

Within a **plantation management unit**, the landscape approach can help to provide tools and methods for trading off various demands from the land including:

- ✓ Timber and fibre
- ✓ Biodiversity
- ✓ Ecosystem services (e.g. water cycle regulation)
- ✓ Other land uses such as pasture

Although from the company's perspective providing a sustainable source of timber and fibre is the dominant objective, wider goals of good environmental and social management means that the others are necessariy taken into account.

The term "landscape" is itself a social construct with an interpretation that will vary between people and in different situations. For practical management purposes here, the landscape can often be taken as being the same as the forest management unit – i.e. the estate containing both plantations and unplanted or conservation areas. However, some of the impacts of the plantation may extend beyond the boundaries of the property owned by Stora Enso.

Elements in landscape planning

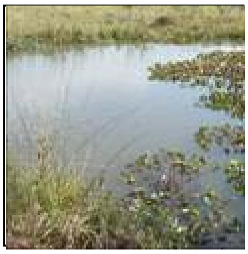
Despite great advaces in understanding of landscape-scale ecology and interactions, many of the practical steps that can be suggested to improve ecosystem health within a plantation remain incompletely understood and in some cases experimental. In applying landscape approaches to plantation management Stora Enso will be able to draw on some excellemt research results from around the world but will also necessarily be learning by doing.

This is not necessarily as daunting as it sounds. Much of landscape planning is a matter of common sense coupled with a general idea of the types of services that the landscape is expected to provide. Amongst the elements that should be considered in a landscape approach within a plantation are (drawing on Rusch et al 2005 but with considerable modifications):

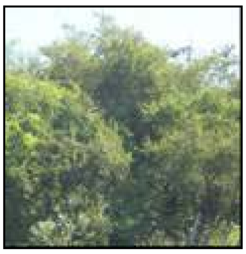
- ✓ **Soil**. **Concept**: identifying (1) soils most suitable for plantations and (2) areas soils that are particularly unsuitable because of their composition, erodability and structure. **Application**: use of CONEAT maps and more detailed site surveys where needed.

- ✓ **Habitats and species**. **Concept**: identifying those habitats that should be excluded from the plantation because of: (1) their overall value such as high conservation value grassland (and including those areas protected by law such as natural forests and wetlands); (2) their value for particular species such as rare or endemic species; or (3) because they are likely to be unsuitable for planting (e.g. steep slopes, too rocky etc).


Marshes and wetlands


Pools, rivers and streams


Habitat of rare species


Native woodlands including *Butia* palm


High conservation grassland


Unsuitable habitats for planting

Application: use of the HCV grassland key, site surveys of other habitats, surveys of species and existing information as necessary. Mapping and protecting valuable areas. Specific illustrative keys can be developed if necessary. **Limitations**: detailed species surveys are expensive and time-consuming

- ✓ **Corridors and connectivity**. **Concept**: ensuring that natural and semi-natural habitats and their associated species are not isolated to allow interchange of genetic material and encourage ecological resilience. **Application**: includes consideration of three elements: (1) preventing barriers to the movement of wild plants and animals, mainly concerned with avoiding the complete isolation of native habitat by plantation or planting trees in such large blocks that movement is impared; (2) conversely mainaining corridors of unplanted areas throughout the landscape and in particular linking natural habitats; (3) ecological stepping stones – small areas of native vegetation retained to provide stopping off points for birds and insects as they move from one native habitat to another. There are important management considerations some of which are addressed in the box below. **Limitations**: much remains to be learned about the practical application of biological corridors (see for instance Nasi 2005) and Stora Enso will need to be prepared to monitor and adapt as necessary.

- ✓ **Riparian corridors**. **Concept**: rivers and streams provide a specific type of corridor, which is protected by law and should be incorporated into overall landscape design. **Application**: all riparian corridors should be free of plantation trees and native woodland should be protected by law – there is a major opportunity to encourage the restoration of additional native woodland areas.

Balancing different priorities in biological corridors

Land set aside from plantations within a particular site is often referred to loosely as “conservation areas” but its value for different aspects of conservation will depend on many individual management decisions. Such land has to fulfil a number of different functions, which need to be traded off, including wildlife habitat, protection for water sources, fire prevention and space for forest management operations (maneuvering heavy machinery, storing timber, roads etc). While many residual areas will have statutory protection (e.g. natural forests, *Butia* palm grassland and wetlands), grassland habitat will not. In managing grassland within buffer zones and corridors various different and sometimes competing factors have to be taken into account:

- ✓ The need to keep grass short enough to provide an effective **fire barrier**
- ✓ Control of **invasive species** including plantation tree species
- ✓ An opportunity to restore more natural campos vegetation including large shrubs as has large disappeared under grazing
- ✓ Conversely evidence that biodiversity declines if grazing is totally removed

Management intentions in residual areas need to be agreed in the same way as for the planted areas themselves. Many such areas will probably be best managed under some form of light grazing although it may be useful to set aside some to develop naturally into bush or woodland (probably separated from the plantation itself to minimise fire risks and impact from invasive species). When planning the plantation sifferent management regimes should be included on the site map.

- ✓ **Buffer zones**. **Concept**: providing buffering capacity for ecosystem functions (particularly hydrological processes) against disturbances caused by the plantation and its management and to reduce the risk of fire. **Application**: identification of areas requiring buffer zones including particularly: (1) significant surface waters; (2) remaining patches of important natural habitat; (3) fire breaks.

- ✓ **Mosaic**. **Concept**: different mixtures of ages of trees, even within the plantation itself, can provide a more attractve habitat for many species than large and uniform areas of even-aged stands. Research in maritime pine plantations in France found that conserving biodiversity in mosaic plantation landscapes helped rare birds and could be achieved by the maintenance of a significant amount of early-successional habitats and deciduous woodland patches within a conifer plantation matrix (Barbaro et al 2007). **Application**: planting uneven-aged stands is against the whole principle of the operation, but planting relatively small stands on one site in different years might be possible, thus creating a mosaic of patches of plantation in different stages of development. **Limitations**: some of the economies of scale inherent in plantation forestry might be lost if such a process were followed.

- ✓ **Genetic reservoir**. **Concept**: one of the aims of biodiversity conservation within the plantation should be to retain the potential for restoration at the end of the plantation project, whenever that might be. Planning should therefore aim to conserve representative samples of existing habitats and species. **Application**: the stages listed previously should address this issue, but the planning process should consider specifically whether management will ensure the survival of a full range of species.

Some of these interactions are shown in conceptual form in Figure 18 below.

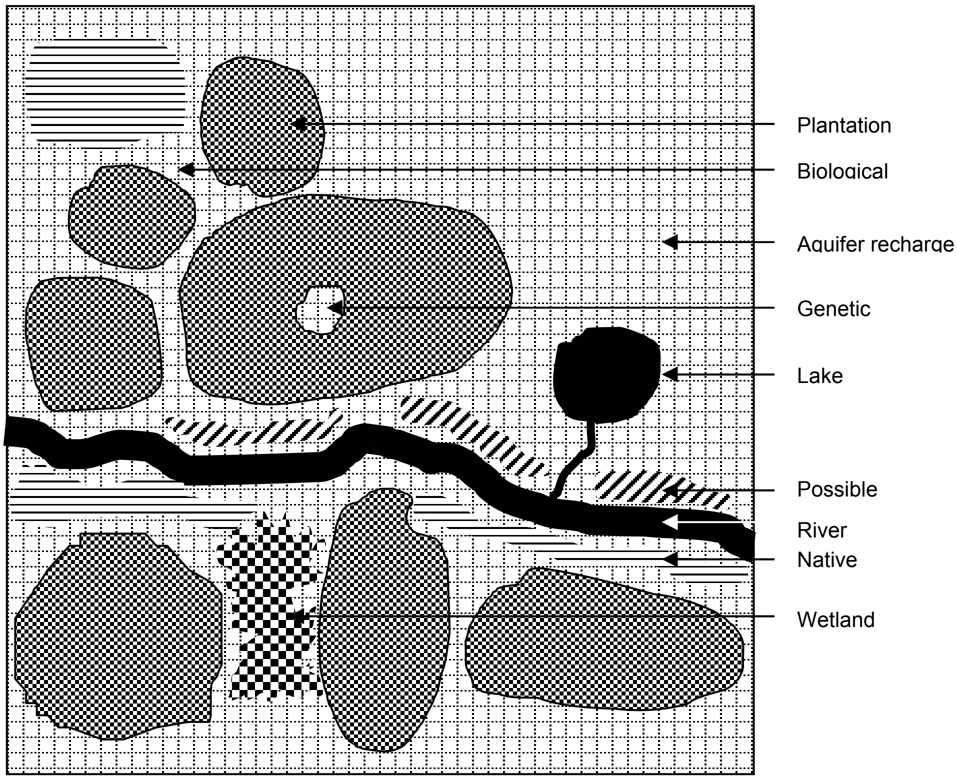


Figure 18: **Some elements of landscape-scale planning**

Landscape outcome assessment methodology

It is proposed that Stora Enso use the Landscape Outcome Assessment Methodology (LOAM) to track in particular stakeholder opinions regarding the project. The following section explains briefly what this might entail.

There is an increasing trend of focusing efforts on developing programmes at a multifunctional landscape level or scale. In developing initiatives that take into account the landscape scale context, one of the biggest challenges is measuring and monitoring the outcomes in terms of key values or functions of the landscape as a whole. Conventional methods of assessing and monitoring project or programme impacts and results do not generally translate well at a broader landscape scale.

In response to the challenges identified above, the *Forests for Life Programme* of WWF has been piloting and testing an approach to identify and put in place a process to track a set of key landscape level outcomes. Currently it is known as the LOAM – Landscape Outcome Assessment Methodology.

LOAM assesses the outcomes and changes in livelihoods resulting from landscape-scale interventions. It is based on performance indicators developed through participatory processes that include a variety of stakeholders

LOAM is an approach to assess the environmental outcomes and changes in peoples' livelihoods resulting from landscape-scale conservation interventions. It is based on simple sets of performance indicators developed through participatory processes that include a variety of stakeholders. This selection of indicators is designed to reflect wider landscape processes, conservation objectives and local people's preferred scenarios. This framework, combined with the use of social learning techniques, helps stakeholders to develop greater understanding of landscape system dynamics and the linkages between livelihood and conservation objectives.

Large scale conservation and development interventions should use these approaches to explore linkages and improve shared understanding of tradeoffs and synergies between livelihood and conservation initiatives. Such approaches provide the basis for negotiating and measuring the outcomes of conservation initiatives and for adapting these to changing perspectives and circumstances (Sayer 2006).

Put simply the approach aims (through a participatory, representative stakeholder process) at the identification and application of a small representative set of locally appropriate indicators grouped under a framework of common key landscape values or assets. From this basis a scoring system is then developed which can be used to measure, monitor and communicate to the range of stakeholders, the nature and extent to which the landscape is changing over time with respect to a small number of commonly identified and agreed conservation and livelihood outcomes.

How and where should the LOAM be applied?

Experience to date is showing that the perceptions and/or expectations and needs of what the LOAM can deliver are very different depending on the situation in each landscape. It is important that these are clarified at the outset in order that the LOAM is applied in the way it is intended, rather than as a proxy for something else. This technique – LOAM – is about understanding landscape change and negotiating with other stakeholders futures for the landscape that will be good for everyone. It is **NOT** about monitoring and evaluation of projects and tracking the direct impacts of project interventions.

LOAM is about understanding how projects or programmes can have an impact within the context of larger landscapes

LOAM is about understanding how projects or programmes can have an impact within the context of larger landscapes. This means that we have to understand what is important for the people in the landscape and we have to know how the landscape is changing and why. That way we can adapt project activities so that, along with all the other things that influence the future of that landscape, they tend to cause it to develop in a positive way.

Figure 1 shows an interpretation of where the LOAM approach fits in a spectrum of scale from a site, through landscape up to the ecoregion or regional level. It also illustrates its recommended role as between project level monitoring at the smaller end of the spectrum and full-blown inter-sectoral scenario building at the region or ecoregional level, although the boundaries are not absolutely distinct and the approaches may overlap slightly with each other in some cases. The diagram then goes on to show some of the other key features of the LOAM, with respect to the other features.

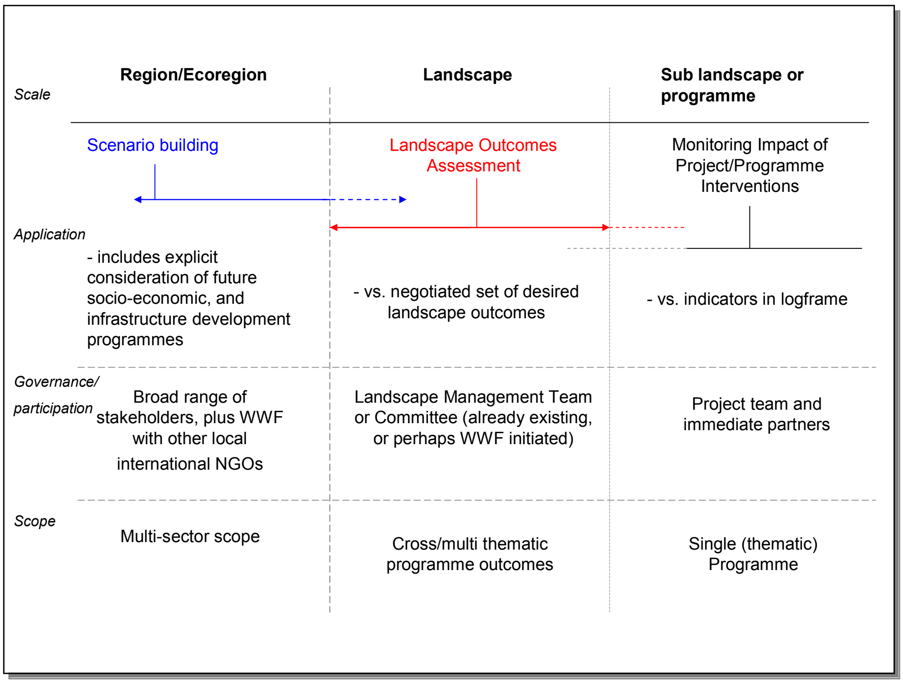


Figure 19: **Relative positioning of LOAM with respect to scale and some key features**

How to implement the LOAM process

A suggested series of key steps is outlined below, although this should not be seen as definitive, and can be adapted to suit circumstances in a particular landscape.

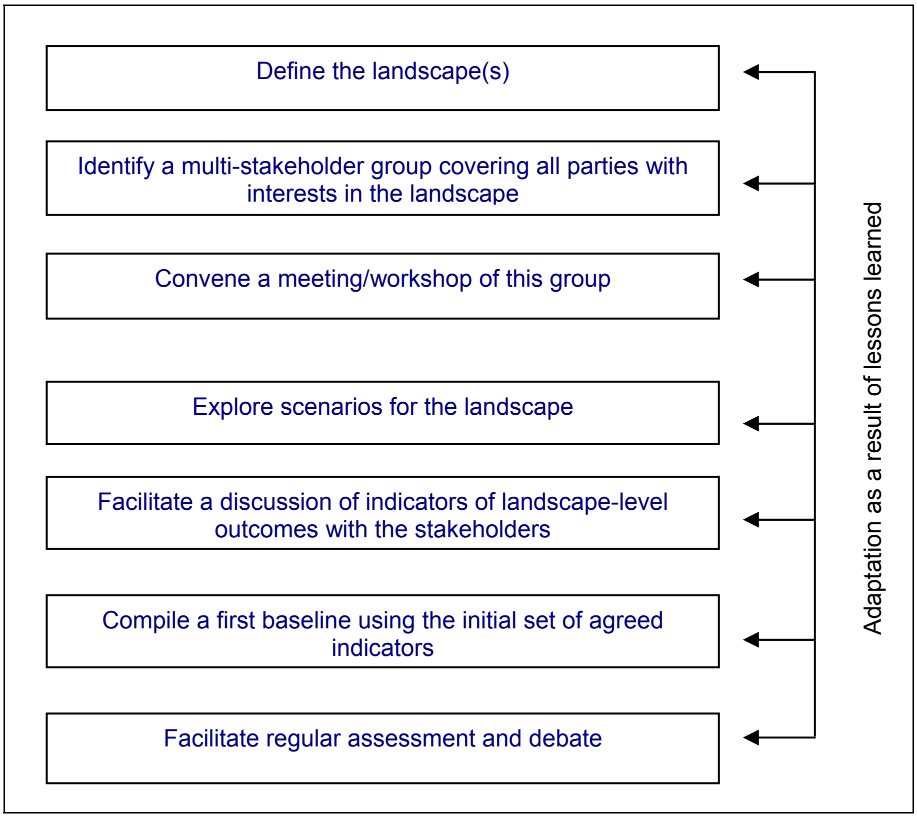


Figure 20: **Implementation of a LOAM process. Note** that there are no arrows between the boxes: **the order given is one possibility but in practice many stages may take place simultaneously**, or at different times in different landscapes

Each of these stages is described in greater detail below.

Define the landscape: the landscape can be defined in terms of a geographic area or something like the "area of distribution of certain habitats like Stony *Campos*". Normally it will be geographic.

Identify a multi-stakeholder group covering all parties with interests in the landscape: this group should include conservation partners, social development NGOs, Government representatives from key sectors, private sector, local community groups and individualities

Convene a meeting or workshop of the multi-stakeholder group: Try to gather as many representatives from the group above as possible to an initial workshop. Experience has shown that it is rarely possible to get all interests equally representatives, but what is important is to initiate a process, and more people may join later.

Explore scenarios in the landscape: This should be a facilitated multi-stakeholder process. A good way to start is to ask participants what for them is the possible future of the landscape. Then discuss the "drivers of change" or external factors that will influence the future of the landscape.

Facilitate a discussion of indicators of landscape-level outcomes with the stakeholders: Encourage a discussion of what would be indicators of "improvements" in the landscape. Ask stakeholders to write down their own list of indicators of progress in the landscape. This can lead to a useful discussion of "*what constitutes success*". Once there is general agreement on ideas for indicators proceed to a more formal discussion guided by the points below:

1. List the indicators: Group the indicators under five categories based upon the Capital Assets, or Sustainable Livelihoods Approach (DfID 1999 – this also serves as a description of "wellbeing"). This was adapted to give five categories of indicators that seem to apply in most of the landscapes:

   1. Human assets
   2. Social assets
   3. Physical assets
   4. Natural assets
   5. Environmental assets

The reasons for using the assets framework are that it encompasses all of the features of a landscape that are likely to be of concern of local stakeholders.

2. Indicators are then defined in a score out of 5 – the so-called Likert scale - which moves across a scale from a value of 1 at the lowest end through increasing levels of "performance" to 5 at the top end: e.g. if the indicator is "Frequency of forest fires", examples of scoring using the Likert scale might be:

   1. Biannual forest fire;
   2. One forest fire per annum;
   3. One fire per annum but stops at forest edge;
   4. <1 fire per annum, not penetrating forest;
   5. No fire

3. The scores can be combined in several visual ways and presented graphically.

Compile a first baseline using the initial set of agreed indicators: Whilst an exceptionally well facilitated and productive workshop may achieve good consensus on a first indicator set and Likert scoring ranges, it is more likely that the framework produced will only be partially complete. In addition the latest data for a specific indicator may not be immediately available, or in the most extreme case need to be collected. Therefore it is best to plan for the time of a technically skilled person, or ideally a small team, for post-workshop follow-up to complete the indicator set and Likert scoring scales, gather and/or collect the required data and compile the first baseline assessment. This process in itself will provide a first feasibility test of the proposed indicator set.

Facilitate regular assessment and debate: After a suitable interval – in most cases yearly – reconvene the group and see if the scores have changed. Two things can happen when you reconvene. First, people will challenge the indicators, arguing that other indicators would have been better or that the the scoring matrix should be different. Debate this – it is part of the process. Second, you may find that the group has difficulty on agreeing on the revised scores. This does not matter; again it is part of the sharing of understanding. What matters finally is that there is a structured debate about whether progress has been made or not. At these periodic meetings people will argue about whether the project is really helping to improve the landscape. This is the most valuable part of the entire process. It is the key to adaptive management. A major outcome of these periodic meetings should be a revisiting of the work plan – are we getting maximum effectiveness in terms of improving the landscape? If not, what should we be doing differently?

Commonly used indicators

Similar indicators tend to emerge from these processes wherever LOAM have been applied. However it is strongly advised against going into a multi-stakeholder meeting with a pre-defined list of indicators. The process of building shared visions requires that stakeholders can all contribute and feel ownership of the process. However it does help if the facilitator has some experience of the sort of indicators that work and those that are difficult to reach agreement on or are difficult to measure objectively. Some indicators that emerged from the SE workshop:

Natural assets

- ✓ Forest extent – or rate of change of forest
- ✓ Numbers of a key species
- ✓ Integrity of critical habitats – e.g. wetlands, grasslands, forests

Environmental assets

- ✓ Frequency of forest fires
- ✓ Quality of water
- ✓ Erosion

Human assets

- ✓ Availability of health care
- ✓ Availability of education
- ✓ Skills and education levels, and opportunities

Social capital

- ✓ Women social integration
- ✓ Employment
- ✓ Services

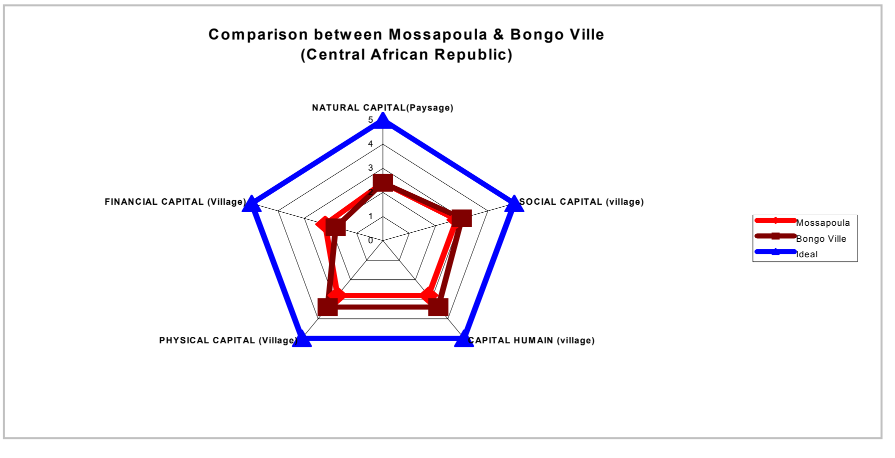
Physical assets

- ✓ Road access
- ✓ Quality of housing
- ✓ Local industries

The number of potential indicators is endless. The value of this is to determine what is really important to the local stakeholders and what they would like to see improve in the short term.

Results Presentation

The results of these indicator measures can be presented in many ways depending upon the objectives and the audience. One way that we have found useful and easy to understand is in the form of a Radar diagram showing the scores of each of the asset categories separately.



High conservation value concept

High conservation value area concept

The concept of High Conservation Values Forest (HCVF) was defined by the Forest Stewardship Council (FSC) for use in forest certification. Now it is increasingly being used in other fields for mapping, nature resource conservation, purchasing policies and policies of government agencies. WWF is also increasingly using the HCVF concept in its conservation programmes, and there is a trend to use the HCV concept both within and separate from certified forests

WWF uses the terminology of High Conservation Value Areas (HCVA) to represent the concept of High Conservation Value Forests derived from the FSC, in non forest habitats. Uruguay is a country where non forest habitats are dominant.

An HCVA is an area containing significant concentrations of biodiversity values of viable ecosystems or provide basic services or needs.

These tools proved a practical method to apply the HCVA concept within a Forest Management Unit, using a three stage approach:

- ✓ Characterisation of the conservation values present
- ✓ Effective conservation of these values
- ✓ Monitoring the conservation status of these values

The HCVA methodology requires users to identify HCVs that cover a wide range of ecological, environmental and social issues and requires an understanding of regional biodiversity issues, animal and plant ranges and behaviour, water and soil resources, ecosystem health, anthropology and local economy. It is very likely that users will not have all of the expertise necessary to evaluate these issues alone. The process is highly reliant upon the input of local and national expert organizations and individuals. External experts and organizations will also be able to provide input on the status of forest types and of rare, threatened and endangered species, and help design management strategies to ensure the maintenance or enhancement of high conservation values

High conservation value assessment

Characterisaton

HCVA is an area containing significant concentrations of biodiversity values, which encompasses species, ecosystems or basic services or needs.

Consultation

Indicator: National expert organizations and individuals provided input on the list of potential values and help design strategies to ensure the maintenance or enhancement of high conservation values
Verifier: List of consulted organisations and individuals

Identificaton

Indicator: Verify if the potential Conservation Values for the Forest Management Unit are identified
Verifier: List of Potential Values

Description

Indicator: Verify if the potential Conservation Values for the Forest Management Unit are described
Verifier: This description must identify for each Conservation Value what are the attributes that characterise the Value and that aloud his effective identification

Mapping
Indicator: Verify if the Conservation Values in presence are identified in the field and mapped through GIS, with the attributes of the Value available in the GIS data base
Verifier: percentage of HCV in the management area

Conservation
Conservation status
Indicator: Verify the Conservation Status classification of the Values in presence
Verifier: % **Degraded** (neither natural species nor ecological processes in place) (D); % **Evolving** (natural species present but ecological processes being restored) (E), and % **Favourable** (natural species and habitat present in a mature phase (F)

Conservation status of a natural habitat means the result of influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory.

Conservation models
Indicator: Verify if there are Models defined for the different Conservation Status (CS) of the Values in presence
Verifier:

- ✓ Conservation status degraded: conservation model – restoration, removal of forest residuals and invasive species. Artificial regeneration

- ✓ Conservation status evolving: conservation model – management, removal of forest residuals and invasive species. Facilitation of natural regeneration

- ✓ Conservation status favourable: conservation model – protection, prevention against invasive species, pests, diseases and fire

Field management
Indicator: Verify in the field if the Conservation Models are being implemented
Verifier: percentage of HCV being effectively conserved

Monitoring
Monitoring the conservation status
Indicator– Verify if the conservation status of the HCVA is being monitored
Verifier: Variation in the conservation status of the area (% Degraded; % Evolutive; % Favourable)

Applying the HCVA concept to Stora Enso plantations in Uruguay

Characterisation

Consultation
The first step in an HCVA assessment requires the contact of relevant experts and stakeholders and/or conducts specific research and consultations.
Accordingly, Stora Enso commissioned a collection of local experts from a wide range of disciplines (see Appendix 1). The expert's consultation process was

conducted in a cross-disciplinary workshop to present results in terms of biodiversity and cultural values for the landscape were their operations will be running.

Identification

Landscape scale

This consultation process has provided the first list and characterisation of conservation values which are potentially present in Stora Enso management units. Section 2 describes their main findings, starting with a summary of key points distilled from a wrap-up workshop in March 2007.

Here we present the list of the Biodiversity Values considered as High Conservation Value at the Landscape Scale:

- Virgin Campos
- Native woodlands
- Riparian woodlands
- Palms
- Rocky outcrop
- Cactus
- Wetlands

High Conservation Socio-cultural Values:

- Archaeological sites

Site Scale

The HCVA identification at the site scale is carried out at Forest Management Unit level. This is a simple methodology to see if HCVAs are likely to occur or not. For this purpose a group of indicators on site selection were set (See Section 5 – Toolkit for site selection). This acts as a coarse filter, rapidly excluding all sites that definitely do not contain HCVAs, and identifying sites that potentially contain specific HCVAs. The preliminary assessment is usually in the form of a "yes or no" question and asks about the presence of certain values.

Description

The description identifies each Conservation Value, and the attributes that characterise the Value and aloud his identification.

High Conservation Value Virgin Campos

The term *Campos* is applied to areas covered by a vegetation of small to medium gramineae, cyperaceous and dicotyledoneous plants, composed of compositae, leguminosae and numerous families with lower frequencies, where shrubs and sub-shrubs are frequent and trees are rare.

Virgin Campos refers to fields that have not been used for agriculture (break up of the vegetable cover, soil disruption, etc.). The structure and composition of the vegetable cover depends mainly on the soil type and the previous grazing management. Annual or perennial exotic weeds are absent or very scarce, sometimes associated with inner roads, paths, salt feeding places or other facilities. According to Rosengurtt (1975), several species are indicators of natural fields, as they disappear after the disruption caused by agriculture, e.g. *Agenium villosum*, *Anemone decapetala*, *Discaria longispina*, *Dorstenia brasiliensis*, *Eryngium sanguisorba*, *Geranium albicans*, *Pavonia hastata*, *Psidium luridum*, *Shizachyrium imberbis*, *Trixis brasliensis*, *Criscia stricta*. Long-life perennial plants predominate in virgin fields, forming an intricate arrangement of tillers and stems in which individual plants are difficult to differentiate. The conservation and proper management of these fields is important because they include a significant floral diversity and a great genetic variability within the populations of the most important productive species. This variability is only noticeable at field level when the ecotypes present significant phenotypical differences. The proportion of this type of field has decreased over time due to diverse productive activities.

The main types of Campos defined by Rosengurtt, are: stony campos, sandy campos, and wetland campos. (See Section 2 – Flora)

High Conservation Value Forests

Forests are comparatively limited in extent. Much woodland has been lost as a result of human actions (Carrere 2001) and natural forests now cover only 3.8 per cent of the country (670,000 hectares) according to a survey carried out in 2000 (FAO 2000). Both natural woodland and palm savannah are protected.

There are differences among forests related to the physiognomy and physiographic characteristics of the areas they occupy, as it is difficult to classify them according to typical species or the most important species from the ecological point of view (See Section 2 – Flora).

High Conservation Value Wetlands and Marshes

Wetlands and marshes include diverse vegetal communities located in flooded areas, either permanent or intermittent, or at least on underground water - that is why they occupy low areas and depressions that gather water and nutrient runoff. However, the physiognomic and floral characteristics vary according to the conditions.

They are usually highly productive ecosystems with specialised vegetation and high bird species richness. Much smaller (and also less well studied) areas, which are nonetheless very important from the floral point of view, occur in low sandstone areas in Rivera and Tacuarembó. Small acid wetlands or marshes are formed next to water courses, with the only Uruguayan location of several species more typical of warmer areas of the Amazonic Domain. In addition to a range of vegetation assemblages (many of which will be single-species stands) wetlands also merge into transition habitats (See Section 2 – Flora).

High Conservation Archaeology Values

For the purposes of classification and to help make recommendations regarding conservation of historical areas and artefacts, the archaeological values has been differentiated into two periods: prehistoric and historic.

Prehistoric records: Four main centres of activity can be identified, each with distinctive features: Littoral sites; Lowland hill mounds; Rock art sites; Stone piles.

Historic records: Since European settlement, two main types of records exist: Rural architecture; Battlegrounds and other historic events.

Cartography

Biodiversity

Landscape scale

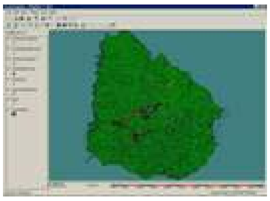
An initial identification of biodiversity hotspots have been made to using flora. The analysis is based first on the presence of tree and shrub species, because their phytogeography is relatively well understood. From this perspective, the Uruguayan woody flora is a southern extension of the Paranaense Province in the east and a south-western extension of the Chaqueña Province in the west: in both cases being at the limit of the typical species of these phytogeographic provinces.

Three forest areas can be identified (see Figure 10 on page ##):
- Forests to the west are typical of woodland extending into Argentina, SE Paraguay and southern Bolivia and are thought to indicate a more arid climate in the past.
- To the east in the "domain of seasonal forests" are mainly river forests and Uruguay is again at their southern limit.
- Less well known, is the woody flora of the cerros chatos (flat hills) in Rivera, which may be part of the flora of Cerrado Province in Brazil.

Drawing on data for woody species and inferring a corresponding richness in other groups, the following hotspots have been suggested (Grela 2004) Using this analysis, it seems that the most important hotspots from the perspective of woody species are not included in the plantation landscape. However, this part of Uruguay is also one of the least studied from a botanical point of view and some of the typical species of areas of endemism may yet be found, e.g. "monte capón" (isolated forest not associated with any water body), riverside forests, etc. Figure 11 shows the origin of herbaria collections of woody species and grasses in Uruguay and the lack of information from the centre of the country is very evident. The Stora Enso plantation landscape is also in a transitional area between the flora of the sub-tropical north and the cooler south (see Section 2 – Flora). Figure 12 shows the area where the main types of woody vegetation are present.

Site Scale

If during the preliminary assessment, using the Site Selection Toolkit, a HCVA was identified in a Forest Management Unit (the answer to the preliminary question was yes), then will need to conduct a more complete or full assessment of the value starting by mapping in a digital format the value distribution.



GIS reference on archaeological and historical sites

Assessments often utilize maps and other information that can be easily accessed by forest managers.

Archaeology

Spatial location of hotspots was performed by geo-reference sites with their respective databases and basic location references. The GIS was organized into two folders: (1) geographic database: hydrography, main and secondary roads, departmental borders and localities; and (2) archeological indicators: littoral sites, mounds, rock art, historical sites and battlegrounds.

Conservation

Stora Enso has not yet applied HCVA as a conservation tool, because the characterisation phase is still on going and all the process is relatively new.

However, this report has identified a potential strategy for the effective protection of the High Conservation Value Areas of SE forest management unit in Uruguay. The idea that private reserves, including those on company-owned land, could be more fully integrated into national protected area systems is one that IUCN the World Conservation Union is promoting.

We identify this as one option for Stora Enso to include set-aside areas of plantations within protected areas in Uruguay (See Section ##).

Monitoring

HCVA's specifically requires a monitoring plan for evaluation of the conservation status of the conservation values. This monitoring plan allows us to understand if our management decisions are getting the expected results in terms of effective protection of the identified HCVA's.

A first approach to a HCVA monitoring plan was developed during the Experts workshop, with a first set of indicators that will be used in the monitoring toolkit. This monitoring tool will include a sub-set of indicators specific to monitor the HCVA's (See table bellow).

Table 43: **Indicators to monitor HCVAs**

Vegetation			
High conservation value (HCV) areas	Regular monitoring of changes to flora and fauna in representative sites		Need to agree number of HCV sites and details of monitoring
Fauna			
Changes in HCV areas		Annual monitoring plan	
- Aquatic communities	Monitoring of benthnic communities and amphibians		
- Terrestrial communities	Monitoring of beetles, reptiles, birds, mammals	Detailed proposals exist	
Archaeology			
Dry-stone structures etc	Monitoring of condition of important cultural sites		Most covered by law

Advice on Environmental Management Systems

The following section contains a summary of best advice available at present.

Existing best management practice

Concerns about the potential social and environmental impacts of plantations have led to the development of a series of guidelines and codes of practice relating to location, choice of species, management and harvesting of plantations. Some of these have been developed for use throughout the world or in major forest biomes, while others have been developed expressly for local needs at national or provincial level, such as those developed in South Africa. Some forest certification systems also have specific requirements for plantations. In addition, there are a far wider range of guidelines relating to general forest management and most of these contain advice that can be applied to aspects of plantation development; for example virtually every state in the USA and Australia has its own agreed forestry guidelines.

Guidelines are produced by industry groups, NGOs, international organisations, research bodies and non-governmental organisations, sometimes in partnership. Most are in the form of best management practices while others are codes of practice or indicators for certification. With the exception of voluntary certification schemes, where many controls will be mandatory for a certified operation, most “best management practices” are a mixture of legal requirements under national or regional laws and suggestions, which are voluntary. It is sometimes difficult to distinguish between the two. A wide range of existing guidelines have been examined and are compared and assessed in the following section. Standards are variable and many of the guides that exist are of limited usefulness, in that it is hard to see how working foresters or forest managers could use them to make substantial changes or improvements to practice. For example, many have the following restrictions:

- ✓ **Vague general demands**: phrases such as “do not damage wildlife” confront managers with a potentially huge management challenge without provide useful information about how to achieve this or advice about prioritisation: general, idealised demands are likely to be ignored or misunderstood.

- ✓ **Undefined exemptions**: many codes include a clause such as “apart from in exceptional circumstances…” or “if reasonably possible…” without giving any advice about what might constitute an exceptional circumstance. Whilst there will often be circumstances in which a particular best management practice is not really necessary, by allowing exceptions without giving any guidance, the whole code is weakened.

- ✓ **Incomplete coverage**: guidelines tend to be very variable in detail, for example typically giving a lot of quite specific and detailed information about buffer zones around streams, bridge-building and road design and construction, but little information about chemical use, wildlife management or social impacts. Most guidelines had limited information about biodiversity and none at all about potential social impacts.

- ✓ **Poor layout**: guidelines are often extremely long, poorly laid out, with no index and with no summary of key points, making it difficult to find specific information and off-putting for busy managers.

International guidelines

A number of attempts have been made to outline best practice for plantations at an international scale. Such approaches have clear limitations, because of the widely varying social and environmental conditions that these must encompass, and also the different aims of plantations, and most have limited themselves to establishing some general principles; the majority have also focused on the wet tropics.

The Food and Agriculture Organization of the United Nations provided a series of guides on key aspects of plantation management starting as early as the 1970s, many of which are still useful, covering such topics as: harvesting (FAO 1976); road building (FAO 1977) and maintenance (Sedlak 1988); and a more general guide to forestry practice that includes many issues relevant to plantations (Dykstra and Heinrich 1995). At a more general level an early review by IUCN outlined environmental concerns and included some preliminary suggestions for best practice (Sawyer 1994). Following that, at an institutional level there have been four general guidelines which are discussed in more detail below:

- ✓ Shell and WWF
- ✓ The International Tropical Timber Organisation (ITTO)
- ✓ The Center for International Forestry Research (CIFOR)
- ✓ Food and Agricultural Organisation (FAO) (*draft*) planted forest code

In the early 1990s, **Shell and WWF** collaborated on a detailed plantation review, which resulted in a 12 volume set of papers including one the outlined 20 principles and some accompanying guidelines for good management (Poore 1993). Both principles and guidelines are general and do not provide many concrete best management practices that plantation managers can follow. The guidelines were clearly aimed at the tropics; they focused more on general principles for choosing sites than on details of management. The publication contains a useful contents list for a feasibility study and tables of positive and negative impacts of plantations with ways of mitigation

One of the most comprehensive global attempts to define principles for plantations is still that of the **International Tropical Timber Organisation** (ITTO 1992). The majority of its 66 principles and associated recommendations are applicable in any conditions. However, they were drawn up for a far less intensive approach than the “fast wood” plantations; for example they have a bias towards replanting with native species and with species mixes. They were developed primarily with a view to protecting existing tropical rainforest and ensuring that local communities did not suffer adversely from plantation development through direct expulsion from traditional lands, neither of which are issues in Uruguay. Notwithstanding, the recommended actions do contain clear proposals that can usefully be incorporated into contemporary best management practices.

The **Center for International Forestry Research** (CIFOR) has produced criteria and indicators for sustainable development of industrial tree plantations in the tropics (Poulsen and Applegate 2001) and a linked code of practice (Applegate and Raymond 2001), which is currently the most detailed and specific available on a global scale. Table 44 outlines the major areas covered by the code, some contain detailed tables and instructions, others more general advice.

Table 44: **CIFOR Code of Practice for plantations in the tropics**

Area	Key issues addressed
Planning	Outline of planning levels
	Summary of main elements that will be identified in land use plans
	Requirements for effective planning (biological, economic, social)
	Information required by planners at stand and site level
Landscape-level planning	Biophysical data needs
	Cadastral data (property data)
	Socio-economic data (tenure, stakeholder involvement, economics etc)
	Environment-biodiversity data
	Exclusion zones – 7 identified and stream typing and buffers explained
Stand-level planning	Buffers, roads, watercourses, contours, firebreaks, landings, skid trails
Roading and drainage	Road classification
	Road design including location and drainage, grade, width and corners
	Road and track construction – timing, survey, drainage, revegetation
Road watercourse crossings	Types and uses
	Construction of bridges, culverts and pipes, fords and silt traps
Quarries	Sources of quarry material
	Quarry management and rehabilitation
Plantation development at a stand level	Planning and pre-harvest activity
	Log landings (location, construction, operations and rehabilitation)
	Planning skid trails including construction and stream gulleys
	Harvesting operations including tree felling
	Log cross-cutting and de-branching plus details of skidding, storage
	Weather limitations on harvesting
	Monitoring and evaluation of development activity including checklist
Log pond and wharf	Location and timing of construction
	Design of log pond, wharf and loading areas
	Maintenance and decommissioning
Plantation establishment	Site preparation including detailed table of options with assessment
	Site preparation on peat soils
	Planting
	Herbicide and pesticide application
	Fertilizer application
	Alternatives to agrochemicals
Employee conditions	Working conditions
	Personnel safety requirements including table of protective clothing
	Equipment safety requirements
Fire management	Education and preparation including checklist for high risk periods
	Fire suppression
Harvesting equipment maintenance	Moving equipment
	Workshop facilities
	Toxic wastes and refuse disposal
	Main fuel and oil storage
	Field servicing and maintenance
Camp hygiene	Design, water supply, waste disposal and drainage
Training systems	Outline of minimum competency standards

Some of the detailed guidelines have been conflated to save space and all have been summarised

Still in draft form, the **Food and Agricultural Organisation** code is currently the most up to date, consisting of 12 principles and five cross-cutting themes. However it should be noted that the document is currently incomplete, lacking references and also being a code rather than guidance it tends to be conceptual: Table 45 below outlines the principles.

Table 45: **FAO Draft Code of Practice for Planted Forests**

Number	Principle
1. Good governance – ensuring stable conditions to encourage long term investments, sustainable land-use practices and socio-economic stability	Transparency Precautionary approach Good policies and legal framework Monitoring of compliance to reduce illegal use Recognition of legal tenure Equitable distribution of benefits Workers rights, including decent wages and rights to organise
2. Integrated decision-making and a multi-stakeholder approach	Integrated approaches within the landscape Encouragement of participation in free, prior-informed consent Conflict resolution mechanisms to resolve disagreements
3. Enhanced organisational capacity	Decentralisation Investment and long-term financing Needs and aspiration of stakeholders Motivated, well-trained workforce Strengthening of research capacity and knowledge-sharing Use of science, traditional knowledge and experience Support for both large- and small-scale investors
4. Recognition of value of goods and services	Balance economic returns with needs of sustainable development Employ full valuation techniques in assessment Use full valuation for justification with investors and governments
5. Promotion of investment – creating enabling conditions	Create a stable and clear investment policy – revised as needed Encourage direct and indirect incentives Avoid perverse incentives and economic distortions Promote equity between competing land uses through policies
6. Recognition of the role of the market	Transparent access to market information Market intelligence information on current markets and trends Policies, regulations and guidelines for stable investment Recognise carbon markets for productive or protective plantations Recognise that the market may not reflect all a forest's values
7. Recognition of social and cultural values	Recognition of rights, values and tenure of indigenous peoples Strengthening capacity of indigenous / local communities to benefit Recognition of the diverse contribution of smallholder investors Provision of employment, training and health and safety equipment Collaboration in strengthening education, health and social services
8. Maintenance of social and cultural services	Establish socio-economic M&E systems and baselines Establish clear conflict resolution mechanisms Provide safe and healthy working environment and conditions Protect sites of archaeological, cultural and spiritual significance Recognise community ancestral rights wherever possible Discourage community displacement without prior informed consent
9. Maintenance and conservation of environmental services	Policy and legal frameworks to preserve / restore env'tal services Maintain and conserve integrated ecosystem functions Adopt integrated watershed and soil management approaches Prepare environmental impact assessments to establish baselines Protect forest crops from wind or other adverse weather conditions Include carbon sequestration and carbon sinks in planning Minimise environmental impacts through operation management Recognise the positive impact plantations can have in restoration
10. Conservation of biological diversity	Adapt management to maintain or conserve biodiversity Protect habitat through stand and landscape-level measures Prepare environmental impact assessments Select appropriate silvicultural systems to protect biodiversity Avoid illegal hunting, trapping, foraging and harvesting of plants Select native species if they are equal to or better than exotics
11. Maintain forest health and productivity	Promote reforestation, soil conservation etc after harvest Reduce risk of invasive species through biosecurity measures Adopt integrated pest management and biological when possible Make efforts to reduce use of herbicides, pesticides, fungicides

Number	Principle
	Dispose of chemical materials, containers and waste carefully
	Adopt sound policies, practices and monitoring in the use of GMOs
	Select species, provenance etc considering objectives, risks and site
	Reduce fires by prediction, prevention, monitoring & rapid response
	Use prescribed fire to minimize risks but not to convert natural forest
	Use fertilizers based specific nutrient requirements
	Support education and training of staff, scientific research etc
12. A landscape approach	Balance plantation success with reduction of environmental risks
	Retain riparian reserves on permanent water courses
	Reduce negative visual impacts of harvesting and forest operations
	Designate reserves within which plantations will be restricted
	Designate buffer zones adjoining communities
	Designate road, stream crossings etc to fit the landscape
	Monitor upstream and downstream water quality and quantity
	Educate local communities and public by outreach programmes
	Design plantations to provide corridors between natural forest areas
	Recognise the continuum of protected areas to plantations

The cross cutting themes provide discussion about some key issues, including:

- ✓ Institutional roles
- ✓ Strategic and economic planning
- ✓ Stakeholder relations
- ✓ Learning research
- ✓ Operational planning and maintenance

National or regional guidelines

A far larger body of literature can be found summarising best practice in a country or a state – our survey below is wide-ranging but by no means comprehensive. The large majority of these guidelines do not distinguish plantations from natural forests, although some separate out planted forests in general. There is inevitably a considerable amount of repetition and, as mentioned above, a large variation in quality. We reviewed over 50 separate guidelines (Dudley 2007 – see Appendix 7) and have extracted what we believe to be the best of these that might help Stora Enso to draw up its IMS and complement the existing forestry code in Uruguay.

Despite the existence of a very wide variety of material on forest management (and this analysis is by no means exhaustive), we have not found any single source that provides the kind of sound guidance that Stora Enso has requested for use in Uruguay. Existing material is in most cases not specific enough, incomplete and designed for a different type or at least intensity of forest management. Most guides aimed more narrowly at plantations are much more useful but focus more on identifying issues to take into consideration rather than providing clear guidance that will be useful to managers in the field.

Nonetheless, the rich library of information that already exists provides us with both a fairly clear idea about what kind of information is needed and some pointers to what can be taken from existing guides and what still needs to be developed. The following table provides a brief summary of what should be included in guidance arising from the current analysis and whether or not this is already available in some form or whether it will need to be built up. It is built on the CIFOR Code of Practice, which seems to provide the most detailed guidelines, with some additions.

Table 46: **Proposed contents for a set of guidelines for plantation management**

Area	Key issues addressed	Availability
Site selection	Biophysical data	Advice mainly limited to forest ecosystems, more needed for grasslands etc
	Socio-economic data	Lists and a wide variety of tools available
	Selection tools	Being developed
Stakeholder consultation	Methodology and principles	Tools available but need to be modified and systematised
Landscape planning within individual sites	Biophysical data	Data needs and tools are available
	Socio-economic data (also relates to surrounding area)	Data needs and tools are available
	Tools for planning (biological corridors, maximum stand size etc)	Being developed
	Exclusion zones to protect natural habitat and reduce environmental impacts	Needs to be developed
	Biological and cultural considerations	Needs to be developed for Uruguay
Planning	Stand level management plan	Advice needed
	Information required by planners at stand and site level	Data available
Stand-level planning	Buffers, roads, watercourses, contours, firebreaks, etc	Forest management information abundant, other values less well covered
Roading and drainage	Road network planning	Advice needed
	Road classification Road design including location and drainage, grade, width and corners Road and track construction – timing, survey, drainage, re-vegetation	Much useful information already available in published sources
Road watercourse crossings	Types and uses Construction of bridges, culverts and pipes, fords and silt traps	Information available
Quarries	Sources of quarry material Quarry management and rehabilitation	[Not clear if this is an issue – need to check]
Plantation development at a stand level	Planning and pre-harvest activity Log landings (location, construction, operations and rehabilitation) Harvesting operations including tree felling Weather limitations on harvesting	Information available but needs to be assessed and modified for use in Uruguay
Log transport system	Location and timing of construction Design of loading areas Maintenance and decommissioning	Difficult to develop guidance on this until more is known
Plantation establishment	Site preparation	Information available
	Planting	Information available
	Herbicide and pesticide application Fertilizer application Alternatives to agrochemicals	Guidance poor and needs development including monitoring
Employee conditions	Working conditions Personnel safety requirements including table of protective clothing Equipment safety requirements	Detailed guidance available (e.g. from the ILO)
Fire management	Education and preparation including checklist for high risk periods Fire suppression	Detailed guidance available

Area	Key issues addressed	Availability
Harvesting equipment maintenance	Moving equipment Workshop facilities Toxic wastes and refuse disposal Main fuel and oil storage Field servicing and maintenance	Detailed guidance available
Camp hygiene	Design, water supply, waste disposal and drainage	
Training systems	Outline of minimum competency standards	
Monitoring and evaluation	Agreed system at site and landscape scale	To be developed using the LOAM system

Significantly in the current context, Uruguay has its own forest code, which is currently voluntary and lays out a detailed approach to best plantation management, as outlined in Table 47 below.

Table 47: **Key elements in the Uruguay Forestry Code**

Number	Principle

1 - Forestry	Site preparation
	    Pre plantation – vegetation control
	    Soil mobilisation
	Planting
	Management
	    Thinning
	    Pruning
	Sanitary control
	    Previous evaluation
	    Control and prevention

2 - Harvesting	Harvesting operations, log cutting and de-branching Skidding Logs storage and loading
3 – Roads, quarries and log ponds	Planning and designing Construction guidelines Maintenance and rehabilitation

4 - Forest fires and fire management	Prevention - Preventive forestry and others
	Fire combat planning
	    Detection
	    Equipment and training
	Fire combat
	    Safety requirements
	    After the fire
	Controlled fire

5 – Chemical products	Storage Application and transportation
6 – Residues	General procedures

7 – Natural resources conservation	Geological characterisation
	Soils
	    Characterisation
	    Corrective activities
	Hydrological resources
	    Characterisation
	    Water quality
	    Basin functions
	    Monitoring
	Biodiversity
	    Characterisation of ecological corridors, ecosystems and species
	    Ecosystems management
	    Buffers

8 – Social and cultural	Local communities Training Landscape

Next steps

Table 48 provides a first attempt to summarise what an IMS might contain – drawing on Table 43 and the Uruguay Forest Code in Table 44. Many issues have been discussed in more detail in other parts of the report: where this is not the case further information is given in the section following. Table 45 loooks at operational stages in the process and does not include, for instance, site planning or stakeholder consultation – i.e. it is more narrowly addressed at the IMS.

Table 48: **Recommendations for an Environmental Management System**

Number	Uruguayan code: main principles	Recommendations and additions (latter in **blue** font)
1 – Forestry	Site preparation	
	Pre plantation – vegetation control	✓ Control of vegetation with minimum amounts of glyphosate or other FSC-approved chemicals. No aerial spraying. Ground-based spraying, avoiding windy conditions. See section below on **spray drift** ✓ Calculation of quantities needed on a site-by-site basis
	Soil mobilisation	✓ Localised ploughing, experimentation with minimum tillage methods ✓ Avoidance of slopes (or contour ploughing on minor slopes).
	Planting and fertilisation	✓ Application of soil analysis data to calculate required fertilizer inputs on a site-by-site basis ✓ Avoidance of fertilizer application in wet conditions or onto bare soil ✓ Continuation of manual planting techniques as those likely to be least environmentally damaging
	Management	
	Thinning	✓ Probably no thinning as long as the trees are for pulp: ew guidance needed if end-uses change ✓ Selection of stems in second rotation of Eucalyptus
		Invasive species control ✓ Manual / mechanical control of eucalyptus and pine in remnant natural forests, *Butia*, wetlands and grassland habitats outside the plantation. See section on **invasive species**
	Pruning	✓ No pruning necessary
	Sanitary control	
	Previous evaluation	✓ Standardised monitoring system to evaluate level of problem and plan site-specific controls ✓ Update evaluation periodically to adapt treatment
	Control and prevention	✓ Prioritise the use of biological controls (e.g. insectivorous birds, predatory invertebrates) by maintaining a living ecosystem ✓ Application of chemical methods only as a last resort ✓ Choice of chemicals restricted to those approved by the FSC
2 - Harvesting	Harvesting operations, log cutting and de-branching	✓ Training – ensuring safety and environmental training for outsourced workers ✓ Provision of full training and safety equipment ✓ Maintenance of regular working

Number	Uruguayan code: main principles	Recommendations and additions (latter in **blue** font)
		hours to avoid tiredness and increased risks ✓ Minimisation of soil compaction through use of tree residues for protection and planning of routes ✓ Maintenance of equipment to minimise safety risks, pollution and erosion impact
	Skidding	✓ Protection of non-planted areas including care of native vegetation (instructions to harvesting workers) ✓ Plan skidding to avoid creating erosion channels (see section on **skidding**)
	Logs storage and loading	✓ Ensure proper training to minimise risks of log-pile collapse
3 – Roads, quarries and log ponds	Planning and designing	✓ Use of existing roads where possible ✓ Where new roads are needed, development of plans to: o Avoid increasing fire risk o Avoid slopes above 5 per cent o Minimise crossings of streams o Avoid isolating habitat See section on **road building** ✓ Care in location of quarries and inclusion of restoration plans for old quarries
	Construction guidelines	✓ Construction of roads within the plantations to minimise detrimental impacts including with respect to o Drainage o Camber o Maximum speed o Size of bridge and water pipes o Material used See section on **road building**
	Maintenance and rehabilitation	✓ Agreement and enforcement of a maximum speed limit for vehicles ✓ Development of procedures to close the roads when not in use for: o Permanent roads o Temporary roads ✓ Miniisation of use of roads during very wet periods ✓ Maintenance of drainage systems
		Transport offsite: ✓ Liaison with local communities about problem times for transport ✓ Development of plans to allow halting of transport during exceptionally wet periods (e.g. increasing storage capacity at the mill) ✓ Liaison with local government about management and maintenance ✓ Provision of financial support for upgrading if this is necessary
4 - Forest fires and fire manage-ment	Prevention - Preventive forestry and others	✓ Use of natural grasslands as fire barriers and adaptation of management as necessary. See section on **fire breaks**
	Fire combat planning	✓ Coordination of fire prevention plan with the management plan and with local and regional authorities ✓ Appointment of fire prevention officer
	Detection	✓ Detection and rapid response plans
	Equipment and training	✓ Purchase and maintenance of fire fighting equipment
	Fire combat	

Number	Uruguayan code: main principles	Recommendations and additions (latter in blue font)
	Safety requirements	✓ Ensuring adequate training of staff regarding fire
	After the fire	✓ Avoidance of erosion risks, through cutting logs to make natural barriers on slopes, stabilisation of eroding areas etc ✓ Restoration, particularly with respect to natural values
	Controlled fire	Not applicable here
5 – Chemical products	Storage	✓ Ensuring adequate training and technical capacity ✓ Construction and maintenance of adequate storage facilities ✓ Safeguarding storage facilities ✓ Development and application of procedures for safe disposal ✓ See section on **chemical transport and storage**
	Application and transportation	✓ Agreement and application of spray drift prevention guidelines (see section on **spray drift**) ✓ Transportation in adequately strong containers
6 – Residues	General procedures	✓ Development and application of a waste minimisation strategy, including separation and classification of wastes and sealing wastes before transportation ✓ Ensuring that storage areas are over 100 metres from buildings and water
7 – Natural resources conser-vation	Geological characterisation	✓ Identification of important geological and archaeological resources
	Soils	
	Characterisation	✓ Use of CONEAT map to choose the best sites for planting ✓ Use of more detailed site-level soil characterisation where needed to help to design the plantation
	Corrective activities	✓ Monitoring to identify possible problems and if necessary application of appropriate response strategies ✓ Ensuring rapid intervention in the case of obvious erosion – through use of a suite of available intervention techniques ✓ Development of a response strategy for restoration in the case of longer-term problems
	Hydrological resources	
	Characterisation	✓ Identification and mapping of aquifer recharge areas and agreement of standards for more detailed analysis in such areas ✓ Classification of superficial waters in terms of permanence, size etc ✓ Inclusion of species of conservation interest in preliminary studies of aquatic status
	Water quality **and quantity**	✓ Setting buffer zones depending on site characteristic, using standardised process ✓ Minimising soil disturbance during harvesting operations ✓ See section on **buffer zones**
	Basin functions	
	Monitoring	✓ Monitoring water quality and quantity over time

Number	Uruguayan code: main principles	Recommendations and additions (latter in **blue** font)
	Biodiversity	
	Conservation areas	✓ Using site selection methodologies to avoid planting or other damage to important wildlife habitat and endangered / endemic species
	Characterisation of ecological corridors, ecosystems and species	✓ Carrying out surveys to identify important species and habitats ✓ Application of landscape design to ensure ecological connectivity and integrity
	Ecosystems management	✓ Planning planting and harvesting operation to minimise impats on biodiversity
	Buffers	✓ Application of buffer zones to protect important habitat remnants (e.g. natural forests, wetlands) as necessary
8 – Social and cultural	Local communities	✓ Promotion of working groups between the company and local communities to ensure good liaison and transparency ✓ Integration of the work of the forest companies with the local productive sectors ✓ Developing communication mechanisms ✓ Developing the concept of multiple use
	Training	✓ Promotion of training of human resources related to forest activity ✓ Outsourced labour included
	Landscape	✓ Taking previous landscape functions into account and take care of the visual perspective
	Human rights approach	✓ Application of a human rights based approach to plantation management

More detailed explanation

The following section contains additional information, where appropriate, on IMS issues not addressed elsewhere in the report.

Use of pesticides and spray drift control

Spray drift during application can cause damage to vegetation in conservation areas, nearby livestock, watercourses, wildlife and people. It can also be hazardous to the spray operator or associated workers, particularly when spray will be applied with a backpack sprayer. Even chemicals like glyphosate, which is generally believed to have low toxicity, can cause irritation and other symptoms if users become contaminated. Following a recommended series of procedures can minimise risks. Policies for controlling drift include (Matthews 1979; Hurst et al 1991):

- ✓ Planning spraying in advance and informing local inhabitants.
- ✓ Avoiding chemicals that damage neighbouring crops or wild plants, and, if possible, those that damage wildlife and beneficial insects.
- ✓ Avoiding using pesticides that can evaporate (volatilise) at a later time and cause drift damage several days after spraying.
- ✓ Selecting the correct nozzle for the operation. Droplets that are too large will bounce off crops and are wasteful of the chemical; drops that are too small will tend to drift away from the target. Investment in

modern equipment that allows precise calibration will pay back in terms of saving on chemical and environmental protection.

- ✓ Calibrating the sprayer with respect to the amount of pesticide required to cover the area to be treated.
- ✓ Ensuring that protective clothing is available up to the standards required and checking the pesticides label to see if special precautions are needed.
- ✓ Ensuring that those applying pesticides and other workers do not smoke during the spraying operation -several pesticides are more toxic if inhaled along with nicotine.
- ✓ Checking the dilution rate of the pesticide.
- ✓ Checking the weather forecast on the day, and also wind speed and direction in the target field. It is safest to spray at about wind force 2 blowing away from susceptible crops or wild areas. Spraying is not advisable at force 4 and over (moderate breeze, moving small branches). Spraying should never be attempted in stormy weather or when strong winds are likely.
- ✓ Switching to a coarser spray if conditions are marginal.
- ✓ Leaving strips unsprayed at the edges of the plantation or near watercourses.
- ✓ Never spraying over water.
- ✓ If conditions are unsuitable, do not spray

Precautions When Filling Equipment

Filling and washing equipment create opportunities for contamination and are the times when operators are in closest contact with the pure (and thus more toxic) pesticide. Carelessness here can lead to human contamination, stream and river contamination and build-up of pesticide residues.

Do not

- ✓ Use bare or gloved fingers to break the seal on a containers
- ✓ Open more than one container at a time
- ✓ Make a direct connection between a domestic water supply and a spray tank
- ✓ Take water from a stream without preventing run-back
- ✓ Decant pesticides between containers and spray equipment if possible
- ✓ Lift containers above shoulder height
- ✓ Return a probe to its holster without washing it
- ✓ Let fine particles of dry pesticide become airborne
- ✓ Clean out equipment near drains or watercourses

Do

- ✓ Use any purpose designed device which is fitted or available
- ✓ Replace the cap/close the container
- ✓ Ensure there can be no run-back of pesticide into the water supply
- ✓ Use an intermediate tanker or system
- ✓ Measure out pesticides only in the appropriate vessel and rinse it immediately
- ✓ Use scales dedicated to the task for powders
- ✓ Use a probe to rinse containers if you can
- ✓ Pour slowly with the container opening positioned so that air can enter
- ✓ If two compatible pesticides are to be mixed together follow the correct procedure and add them to water separately in the recommended order
- ✓ Measure out powders in still air conditions

Mixing is a skilled activity and should only be undertaken by one or a small number of reliable staff, who should be trained and accredited to do this work.

Chemical storage and disposal

A special storage shed for pesticides should be constructed and should:

- ✓ Be built well away from houses, crops, livestock, inflammable materials and water
- ✓ Have walls, floor and roof, which are fire and corrosion resistant, impervious to liquids and insulated
- ✓ Be able to contain spillage e.g. through construction of a raised sill and an external watertight tank to store spilled liquids
- ✓ Be provided with suitable entrances and exits
- ✓ Include natural ventilation or extractor fans to avoid build-up of fumes
- ✓ Have sufficient lighting so that all labels can be read, while avoiding direct sunlight because of the risk of spontaneous combustion if chemicals became too warm
- ✓ Be heated well enough to avoid frosts, especially when storing liquids
- ✓ Be theft-, vandal- and animal-proof with a clear sign displayed giving warning that poisons are stocked within
- ✓ Include washing facilities and a place to store protective clothing
- ✓ Include stock rotation and an accountability system

Invasive species

Invasive species are identified as one of the major threats to biodiversity, particularly amongst plants. Prevention is far better than cure; experience shows that once a successful invasive species is established it is difficult or impossible to eradicate. Several steps are important:

- ✓ Taking care in the choice of plantation species to avoid those that are likely to spread into native woodlands or other habitats – for example the locust tree (*Robinia*) has become a well-known invasive species in Europe.
- ✓ Ensuing careful hygiene in seeds and imported material to avoid introduction of pests and diseases.
- ✓ Introducing eradication or control processes for nuiance invasive species associated with plantations (for example it may be necessary to carry out control of wild boar if these start to damage neighbouring crops)
- ✓ Training of staff to recognise known or possible invasive species.
- ✓ Development and implementation of a pest control programme

Road building and use

Roads can create a range of environmental and social problems, both inside and outside the plantation. Construction and use of forest roads and tracks often constitutes the main cause of increased sediment load following logging operations in plantations. The following guidelines provide a summary of principles that should be followed to minimise these risks (see Burrough and King 1989, FAO 1977 and 1992 and Sedlak 1988a and 1988b)

Design and planning

Basic design can help avoid or minimise many of the underlying problems outlined above.

- ✓ Planning a comprehensive road network, with roads divided into permanent and temporary roads as appropriate
- ✓ Appointing specialist staff, at least at the stages of design and initial implementation

- ✓ Minimising road length through use of careful planning, to reduce erosion potential, loss of growing area and construction costs. Choice of harvesting method can also reduce road length
- ✓ Minimising disturbance associated with roads including restricting average width of forest road to a minimum that will permit safe maintenance and hauling
- ✓ Using ridge-tops wherever feasible, to minimise chances of erosion and watercourse degradation
- ✓ Minimising road gradient with maximum grades of 10-20 per cent recommended, with shorter steep slopes if necessary

Reducing risks of soil erosion

- ✓ Avoiding high erosion areas with wet soils, poor load-bearing soils, highly erosive soil types and steep slopes
- ✓ Grading roads to minimise erosion: a minimum road grade of around 3 per cent is needed to prevent surface puddling – on an earth road a uniform cross slope is the best way to achieve this.
- ✓ Compacting the road base to allow the road to dry thoroughly before use. Ideally, roads should be constructed during the dry season and allowed to consolidate before being used by heavy machinery
- ✓ Installing ditches and culverts, designed to handle floods.
- ✓ Ensuring re-vegetation on banks and slopes cut during road construction, for example by seeding, in order to minimise erosion.
- ✓ Protecting roads through choice of vehicle and use including minimising axle weight, reducing speed, minimising use in wet conditions and reducing tyre pressure on unsurfaced roads

Crossing streams and avoiding damage to watercourses

- ✓ Building well-designed bridges and culverts, designed to handle the maximum expected water flow. Bridge and culvert backfills should be stabilised with barriers or vegetation to minimise erosion. Cuts and fills should be stabilised with retaining walls where there is danger of slippage into watercourses.
- ✓ Avoiding build-up of sediment in streams
- ✓ Avoiding damage to streambeds by keeping machinery activity in streambeds to an absolute minimum
- ✓ Planning stream crossings with care by choosing sites for temporary stream crossings where they cause minimal soil disturbance and crossing only at right angles
- ✓ Avoiding chemical pollution to watercourses from oils, chemicals and excessive concrete during road building
- ✓ Avoiding erosion by using cut-off drains, silt traps or pools to reduce risk of erosion and ensuring that drainage channels have gradients below 2 per cent.
- ✓ Minimising storm damage by ensuring that culverts remain clear.

Protecting settlements

- ✓ Minimising pollution and noise from roads including by providing green strips to screen out dust and noise, particularly around villages and watercourses

Protecting roads during operations

- ✓ Using speed limits, particularly around settlements
- ✓ Regulating the size and weight of vehicles using roads: axle loads and weight should also be reducedif possible when weather conditions are wet
- ✓ Practising regular maintenance including cleaning out ditches and culverts immediately after harvesting to prevent disruption of streams and increase in soil erosion.

- ✓ Closing off to traffic any road liable to serious rutting or damage during wet-soil conditions

Skidding routes

Damage to soil can be minimised during skidding operations through appropriate planning, operational practices and use of protective material (Bol and Beekman 1989, Clayton 1990, Dykstra and Heinrich 1996, Froehlich et al 1981 and Gottfried 1987). Key points include:

- ✓ Developing a network of designated skidding trails, using offcuts to provide a protective surface and minimise soil damage
- ✓ Avoiding side cutting on steep slopes
- ✓ Avoiding routing skid trails across streams or in stream buffer zones
- ✓ Provision of drainage ditches and cross-drains
- ✓ Suspending skidding operations during very moist soil conditions
- ✓ Where soils are easily compacted, considering use of low-ground-pressure skidders or “high flotation” tyres to reduce soil disturbance

Section 5
Conclusions

Significant environmental, social and economic considerations

Note that after the IMS is finished in late August this section will also include a more complete analysis of Stora Enso's plans

Question to SE: Do you want more details here? I have kept this brief but could be expanded…

Environment: key issues

■ **Biodiversity**: **recognition of the key importance of grasslands and inclusion of conservation measures for grassland within management strategies** including:

- ✓ **High conservation value areas** – using field keys to identify the highest value grasslands. In extreme cases not buying land for plantations if it is going to degrade the most important habitat; more usually deciding where to plant within a plot to preserve the most valuable grassland areas
- ✓ **Good management and restoration** (grassland and other habitats). This covers all high quality grassland but also natural woodland, *Butia* palm areas and wetlands and includes both avoidance of planting and positive management measures to maximise and improve conservation values
- ✓ **Private protected areas** through set-aside areas. Active exploration with government protected area agencies of the potential for adding set aside areas to be part of the national protected area network, which is currently being expanded
- ✓ **Landscape approaches** to planning, creating a viable mosaic of linked natural and semi-natural habitats – using a series of tools (corridors, stepping stones, multiple-aged forest stands, buffer zones, artificial habitats etc) to maintain biodiversity within the plantation estate. Should include HCVA planning, ecosystem integrity and trade-offs of land use.

■ **Water balance: care to avoid localised impacts on neighbours through**:

- ✓ **Aquifers**: avoid planting in aquifer recharge areas through use of the forest suitability map to identify higher risk areas and within these carrying out site surveys
- ✓ **Superficial water quality** avoid planting close to standing or running water to reduce impacts on water quantity and quality
- ✓ **Superficial water quantity** both regarding individual impacts within a site and also avoiding over-planting within a single watershed

■ **Environmental management system**: **building on the Uruguay Forestry Code and focusing on key areas often neglected in management including**: [refer to full list]

- ✓ **Transport policy** to avoid the social and environmental impacts of transport incliding for example liaison with local communities to avoid transport during key periods (mass etc) and avoiding transport in weather conditions likely to lead to road deterioration – for example by increasing the wood store size at the mill to allow suspension of transport in bad weather

- ✓ **Agrochemical use** with particular emphasis on worker safety, site-specific fertilizer use, avoiding drift of herbicides and minimum use of safest possible pesticides against ants

- ✓ **Worker safety** regarding in particular machinery use, safety equipment, chemical handling

- ✓ **Outgrower schemes** requirement for application of IMS for all timber used by the company including from outgrower schemes

Society: key issues

■ **Transparency**: **full information to local communities (currently not always being done) through**:

- ✓ **Stakeholder involvement:** Regular meetings (including the LOAM process) to ensure that the local communities know what is happening, including meeting with workers' groups (including trades unions), local officials and villagers. Specific liaison officers should be responsible for community relations (note that this will usually not be a full time job and may for instance be the local manager but the role should be explicitly identified and terms of reference developed)

- ✓ **Communication**: Publicity materials including leaflets, article in local newspapers, radio interviews etc

■ **Contractors**: **ensuring that contractors maintain the high standards of the company and employ the full Environmental Management System etc through**:

- ✓ **Standards** created by clear guidance and terms of reference in contracts setting out requirements for safety, treatment of workers, environmental and social issues (we note there is already a draft in place), backed up by training courses for contracted workers where necessary

- ✓ **Internal evaluation and monitoring** of contractors through a standardised annual scoring system, to provide a positive discrimination system, leading to construcitve, evolving long tem relationships with key contractors. This should ensure stability and encourage companies to have a stake in the long-term future of the project.

■ **Local benefits**: ensure that a reasonable proportion of the benefits reach local communities including by

- ✓ **Increasing local economic opportunities** including where possible jobs for people from local communities and deliberate use of local services

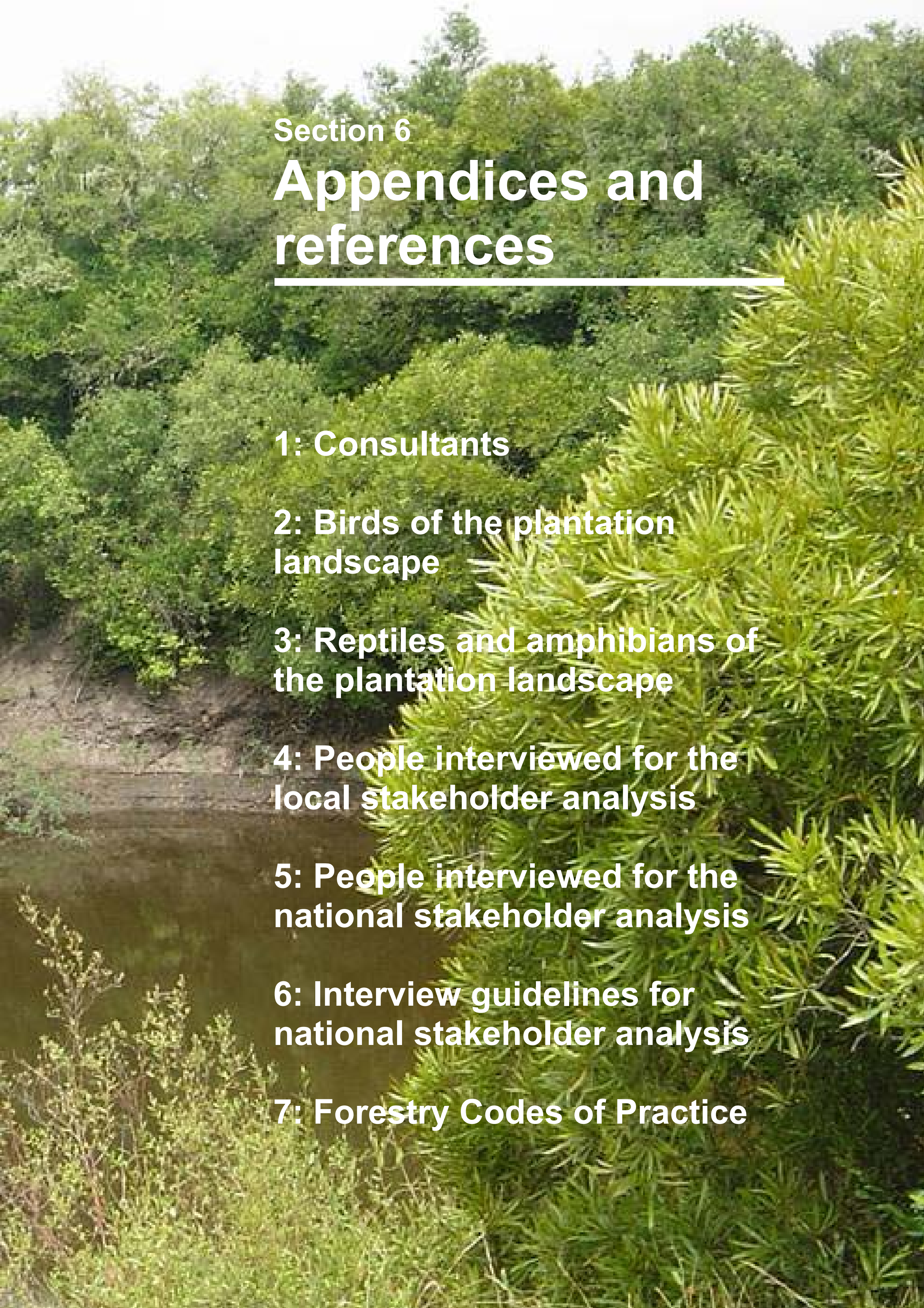
- ✓ **Encouraging local benefits** through supporting additional training opportunities for local workers and additional benefits such as access to beekeepers

Human rights approach

We provide (see page ##) a draft outline of a "human rights approach" to plantation management. Many of the elements address issues of concern alreadyt raised by stakeholders. In the following matrix we take the list of human rights, match it with concerns raised by stakeholders and make some suggestions for how Stora Enso could respond to these issues.

Human Rights Approach	Stakeholder concerns	Possible responses from Stora Enso
Avoid population displacement[10]	Labour coming in from outside the region	Positive support for local people in jobs. Employment of local managers wherever possible
Respect for customary institutions and norms	Transport of logs along roads in bad weather conditions leading to damage	Road maintenance, good rules for transport. Building longer storage capacity at the mill to allow suspension of transport in bad weather
Avoid harm to resources for local communities	Loss of surface water flow in neighbouring lands,	Careful monitoring and published response plans if water resources alter significantly
	Increase of fire risks, number of poisonous snakes created by in drier conditions	
	Possibility of pollution of neighbouring waters and damage to fish	Careful monitoring with users including fishing unions
	Failure to control exotic pest species	Effective pest management
Ensure security, free assembly and speech	Poor community relations	Regular meetings, information to communities, identified contact points
Support rights for information	Lack of information about the project	Regular printed information, meetings etc
Promote further human rights		Support and training for local communities to take advantage of opportunities provided by the project.
Ensure workers' rights, health & safety etc	Poor management of outsourced tasks – fears that Stora Enso's policies will be irrelevant if out-sourced work is of poor quality	Strong control & training of outsourced labour
	Poor pesticide safety leading to health impacts on workers	Strong Environmental Management System
Guarantee that labour is not forced	Not mentioned	
Ensure against all forms of discrimination	Job losses, lack of training	Promote jobs for women
Guarantee freedom of association	Antipathy to organised labour	Open dialogue with trades unions
Avoid child labour	Not mentioned	

[10] In many situations this would involve displacement of people from plantation sites, but this is not usually the case in Uruguay



Section 6

Appendices and references

1: Consultants

2: Birds of the plantation landscape

3: Reptiles and amphibians of the plantation landscape

4: People interviewed for the local stakeholder analysis

5: People interviewed for the national stakeholder analysis

6: Interview guidelines for national stakeholder analysis

7: Forestry Codes of Practice

Appendix 1: consultants

The majority of the consultants were from Uruguay and were emploed on a fairly hsort term basis to collect information and take part in the workshops identifying indicators. A small team of global consultants were also used to collect information on specific topics or because they had particular expertise. The following summarises information on all those involved in the assessment [still incomplete]

Physical geography and geology
Jorge Montaño Xavier (geology)
Mauricio Montaño (geology)
Sergio Gagliardi (geology)
Ximena Lacués (geology)

Fauna
Susana González (mammals)
Mario Clara (birds)
Enrique Morelli (insects)
Patricia González (insects)
Gabriela Bentancur (insects)

Flora
Pablo Boggiano (grasslands)
Carlos Brussa (wetlands)
Iván Grela (woodland)

Historical heritage

Arturo Toscano
Andrés Florines
Prof. Jorge Femeninas

Social issues
Leticia Cannella (anthropologist)
Enrique Gallicchio (socologist)
Viviana Martínez (socologist)
Grazia Borrini-Feyerabend (IUCN Commission on Environmental, Economic and Social Policy)
Jessica Campese (TILCEPA)

Forest management

Luis Neves Silva (forester, based in Portugal)
Stephanie Mansourian-Stephenson (consultant based in Switzerland)
Jeffrey Sayer (monitoring and evaluation)

Coordinator
Nigel Dudley

Support in Stora Enso
Kaisa Tanra-Maini
Horacio Giordano
Andrea Storace

Appendix 2: Birds of the plantation landscape

The main resident and migratory species are outlined in Tables 49 and 50 below.

Table 49: **Main resident species in the plantation landscape**

Species	Common name	Status
Rhea Americana	Greater Rhea	Co
Rynchotus rufescens	Red-winged tinamou	Co
Nothura maculosa	Spotted tinamou	Co
Podylimbus podiceps	Pied-billed Grebe	Co
Rollandia Rolland	White-tufted Grebe	Co
Podiceps major	Great Grebe	Co
Phalacrocorax brasilianus	Neotropic Cormorant	Co
Anhinga anhinga	Anhinga	Pc
Botaurus pinnatus	Pinnated Bittern	Pc
Ixobrychus involucris	Stripe-backed Bittern	Pc
Tigrisoma lineatum	Rufescent Tiger-heron	Pc
Nycticorax nycticorax	Black-crowed Night-heron	Co
Ardeola ibis	Cattle Egret	Co
Syrigma sibilatrix	Whistling Heron	Co
Butorides striatus	Striated Heron	Co
Egretta thula	Snowy Egret	Co
Casmerodius albus	Great Egret	Co
Ardea cocoi	White-necked Heron	Co
Ciconia maguari	Maguari Stork	Co
Harpiprion caerulescens	Plumbeous Ibis	Co
Theresticus caudatus	Buff-necked Ibis	Pc
Phimosus infuscatus	Bare-faced Ibis	Co
Plegadis chihi	White-faced Ibis	Co
Ajaia ajaja	Roseate Spoonbill	Co
Chauna torquata	Southern Screamer	Co
Dendrocygna bicolour	Fulvous Tree-duck	Co
Dendrocygna viduata	White-faced Tree-duck	Co
Cygnus melancoryphus	Black-necked Swan	Co
Coscoroba coscoroba	Coscoroba Swan	Pc
Cairina moschata	Muscovy Duck	Ra
Amazonetta brasiliensis	Brazilian Duck	Co
Anas flavirostris	Speckled Teal	Co
Anas georgica	Brown Pintail	Co
Anas sibilatrix	Southern Wigeon	Pc
Anas versicolor	Silver Teal	Co
Cathartes aura	Turkey vulture	Co
Cathartes burrovianus	Lesser Yellow-headed Vulture	Pc
Coragyps atratus	Black Vulture	Pc
Elanus leucurus	White-tailed Kite	Co
Geranospiza caerulescens	Crane Hawk	Ra
Circus buffoni	Long-winged Harriere	Co
Circus cinereus	Cinereous Harrier	Ra
Accipiter bicolour	Bicoloured Hawk	Ra
Accipiter striatus	Sharp-shinned Hawk	Pc
Buteogallus urubitinga	Great Black Hawk	Ra
Heterospizas meridionalis	Savannah Hawk	Pc
Geranoaetus melanoleucus	Black-chested Buzzard-eagle	Pc
Parabuteo unicinctus	Bay-winged Hawk	Pc
Buteo magnirostris	Roadside Hawk	Co
Polyborus plancus	Crested Caracara	Co
Milvago chimachima	Yellow-headed Caracara	Pc
Milvago chimango	Chimango Caracara	Co
Falco femoralis	Aplomado Falcon	Pc
Falco sparverius	American Kestrel	Co
Penelope obscura	Dusky-legged Guan	Co
Aramus guaruana	Limpkin	Co
Ortygonax sanguinolentus	Plumbeous Rail	Co
Pardirallus maculates	Spotted Rail	Ra
Aramides cajanea	Grey-necked Wood-Rail	Co
Aramides ypecaha	Giant wood-Rail	Co
Laterallus leucopyrrhus	Red-and-White Crake	Pc
Laterallus melanophaius	Rufous-sided Crake	Co
Coturnicops notata	Speckled Crake	Ra
Porphyriops melanops	Spot-flanked Gallinule	Co
Gallinula chloropus	Common Gallinule	Co
Fulica armillata	Red-gartered Coot	Co

Species	Common name	Status
Fulica rufifrons	Red-fronted Coot	Co
Cariama cristata	Red-legged Seriema	Pc
Jacana jacana	Wattled Jacana	Co
Nycticryphes semicollaris	South American Painted-Snipe	Pc
Himantopus mexicanus	South American Stilt	Co
Vanellus chilensis	Southern Lapwing	Co
Charadrius collaris	Collared Plover	Co
Gallinago paraguaiae	Common Snipe	Co
Larus cirrocephalus	Grey-hooded Gull	Pc
Larus dominicanus	Kelp Gull	Co
Larus maculipennis	Brown-hooded Gull	Co
Phaetusa simplex	Large-billed Tern	Pc
Gelochlidon nilotica	Gull-billed Tern	Co
Sterna superciliaris	Yellow-billed Tern	Co
Columba maculosa	Spot-winged Pigeon	Co
Columba picazuro	Picazuro Pigeon	Co
Zenaida auriculata	Eared Dove	Co
Columbina picui	Picui Ground-Dove	Co
Leptotilia rufaxilla	Gray-fronted Dove	Pc
Leptotilia verreauxi	White-tipped Dove	Co
Aratinga acuticaudata	Blue-crowned Parakeet	Ra
Aratinga leucophthalmus	White-eyed Parakeet	Pc
Myiopsitta monachus	Monk Parakeet	Co
Piaya cayana	Squirrel Cuckoo	Pc
Crotophaga ani	Smooth-billed Ani	Pc
Guira guira	Guira Cuckoo	Co
Tyto alba	Barn Owl	Pc
Otus choliba	Tropical Screech-Owl	Co
Bubo virginianus	Great Horned Owl	Pc
Glaucidium brasilianum	Ferruginous Pygmy-Owl	Ra
Speotyto cumicularia	Burrowing Owl	Co
Pseudoscops calmator	Striped Owl	Pc
Asio flammeus	Short-eared Owl	Pc
Leucochloris albicollis	White-throated Hummingbird	Co
Ceryle torquata	Ringed Kingfisher	Co
Chloroceryle amazona	Amazon Kingfisher	Co
Chloroceryle Americana	Green Kingfisher	Co
Picumnus nebulosus	Mottled Piculet	Pc
Melanerpes candidus	White-fronted Woodpecker	Co
Picoides mixtus	Checkered Woodpecker	Pc
Veniliornis spilogaster	White-spotted Woodpecker	Co
Colaptes campestris	Field Flicker	Co
Colaptes melanochloros	Green-barred Woodpecker	Co
Drymornis bridgesii	Scimitar-billed Woodcreeper	Co
Lepidocolaptes angustirostris	Narrow-billed Woodcreeper	Co
Geositta cunicularia	Common Miner	Pc
Furnarius rufus	Rufous Hornero	Co
Limnornis curvirostris	Curve-billed Reedhaunter	Pc
Phleocryptes melanops	Wren-like Rushbird	Co
Lepatsthenura platensis	Tufted Tit-Spinetail	Pc
Schoeniophylax phryganophila	Chotoy Spinetail	Pc
Synallaxis frontalis	Sooty-fronted Spinetail	Co
Synallaxis spixi	Chicli Spinetail	Co
Certhyaxis cinnamomea	Yellow-throated Spinetail	Ra
Cranioleuca pyrrhophia	Stripe.crowned Spinetail	Co
Cranioleuca sulphurifera	Sulphur-beared Spinetail	Pc
Asthenes baeri	Short-billed Canastero	Pc
Asthenes hudsoni	Hudson's Canastero	Pc
Phacellodomus striaticollis	Freckle-breasted thornbird	Co
Anumbius annumbi	Firewood-gathered	Co
Pseudoseisura lophotes	Brown Cachalote	Pc
Syndactyla rufosuperciliata	Buff-browed Foliage-gleaner	Co
Lochmnias nematura	Sharp-tailed Streamcreeper	Pc
Thamnophilus caerulescens	Variable Antshrike	Co
Thamnophilus ruficapillus	Rufous-capped Antshrike	Co
Sublegatus modestus	Scrub Flycatcher	Pc
Suiriri suiriri	Siuriri flycatcher	Pc
Serpophaga nigricans	Sooty Tyrannulet	Co
Serpophaga subcristata	White-crested Tyrannulet	Co
Pseudocolopteryx flaviventris	Warbling Doradito	Pc
Phylloscartes ventralis	Mottled-cheeked Tyrannulet	Co
Xolmis cinerea	Gray Monjita	Co
Xolmis irupero	White Monjita	Co
Heteroxolmis dominicana	Black-and-white Monjita	Pc

Species	Common name	Status
Knipolegus cyanirostris	Blue-billed Balck Tyrant	Co
Knipolegus lophotes	Crested-black Tyrant	Pc
Hymenops perspicillatus	Spectacled Tyrant	Co
Satrapa icterophrys	Yellow-browed Tyrant	Co
Machetornis rixosus	Cattle Tyrant	Co
Pitangus sulphuratus	Great Kiskadee	Co
Anthus correndera	Correndera Pipit	Pc
Anthus furcatus	Short-billed Pipit	Co
Anthus hellmayri	Hellmayr's Pipit	Pc
Anthus lutescens	Yellowish Pipit	Pc
Troglodytes aedon	House Wren	Co
Mimus saturninus	Chalk-browed Mockingbird	Co
Turdus albicollis	White-necked Thrush	Pc
Turdus amaurochalinus	Creamy-bellied Thrush	Co
Turdus rufiventris	Rufous-bellied Thrush	Co
Polioptila dumicola	Masked Gnatcatcher	Co
Zonotrichia capensis	Rufous-collared Sparrow	Co
Ammodramus humeralis	Grassland Sparrow	Co
Donacospiza albifrons	Long-tailed Reed-finch	Co
Poospiza lateralis	Red-rumped Warbling-Finch	Co
Poospiza nigrorufa	Black-and-rufous Warbling-finch	Co
Sicalis flaveola	Saffron Finch	Co
Sicalis luteola	Grassland Yellow-Finch	Co
Embernagra platensis	Great Pampa-Finch	Co
Emberizoides ypirangus	Lesser Grass-Finch	?
Gubernatrix cristata	Yellow Cardinal	Ra
Coryphospingus cucullatus	Red-crested Finch	Ra
Paroaria coronata	Red-crested Cardinal	Co
Volatinia jacarina	Blue-black Grassquit	Co
Saltator aurantiirostris	Golden-billed Saltator	Co
Saltator similes	Green-winged Saltator	Pc
Piranga flava	Hepatic Tanager	Co
Thraupis bonariensis	Blue-and-yellow Tanager	Co
Thraupis sayaca	Syaca Tanager	Co
Stephanonphorus diadematus	Diademed Tanager	Co
Pipraeidea melanota	Fawn-breasted Tanager	Pc
Tangara preciosa	Chestnut-backed Tanager	Co
Parula pitiayumi	Tropical Parula	Co
Basileuterus culicivorus	Golden-crowned Warbler	Co
Basileuterus leucoblepharus	White-browed Warbler	Co
Cyclarhis gujanensis	Rufous-browed Peppershrike	Co
Icterus cayanensis	Epaulet Oriole	Co
Cacius chrysopterus	Golden-winged Cacique	Co
Cacius solitarius	Solitary Black Cacique	Co
Agelaius ruficapillus	Chestnut-capped Blackbird	Co
Sturnella defilippii	Lesser Red-breasted Meadowlark	Ra
Sturnella superciliaris	White-browed Blackbird	Co
Pseudoleistes guirahuro	Yellow-rumped Marshbird	Pc
Pseudoleistes virescens	Brown-and-yellow Marshbird	Co
Amblyramphus holosericeus	Scarlet-headed Blackbird	Pc
Gnorimopsar chopi	Chopi Blackbird	Pc
Molothrus badius	Bay-winged Cowbird	Co
Molothrus bonariensis	Shiny Cowbird	Co
Molothrus rufoaxillaris	Screaming Cowbird	Co
Carduelis magellanica	Hooded Siskin	Co
Cyanocorax chrysops	Purplish Jay	Co

Table 50: **Main migrant species in the plantation landscape**

Species	Common name	Summer	Winter	Status
Mycteria Americana	Wood-Stork	■		Co
Netta peposaca	Rosy-billed Pochard		■	Co
Rosthramus sociabilis	Everglade Kite	■		Co
Buteo albicaudatus	White-tailed Hawk	■		Pc
Buteo polysoma	Red-backed Hawk		■	Ra
Buteo swainsoni	Swainson's Hawk	■		Pc
Falco peregrinus	Peregrine Falcon		■	Pc
Falco peregrinus	Peregrine Falcon	■		Pc
Porzana flaviventer	Yellow-breasted Crake	■		Ra
Porphyrula mattinica	Purple Gallinule	■		Pc
Pluvialis dominica	Golden Plover	■		Co
Charadrius falklandicus	Two-banded Plover		■	Ra
Eudromias ruficollis	Tawny-throated Dotterel		■	Pc
Bartramia longicauda	Upland Sandpiper	■		Pc
Tringa flavipes	Lesser Yellowlegs	■		Co
Tringa melanoleuca	Greater Yellowlegs	■		Pc
Tringa solitaria	Solitary Sandpiper	■		C
Calidris fuscicollis	White-rumped Sandpiper	■		Co
Calidris melanotos	Pectoral Sandpiper	■		Co
Tryngites subruficollis	Buff-breasted Sandpiper	■		Pc
Rynchops nigra	Black Skimmer		■	Co
Coccyzus americanus	Yellow-billed Cuckoo			
Coccyzus cinereus	Ash-coloured Cuckoo	■		Ra
Coccyzus melacoryphus	Dark-billed Cuckoo	■		Pc
Tapera naevia	Striped Cuckoo	■		Co
Chordeiles minor	Common Nighthawk	■		Ra
Podager nacunda	Nacund Nighthawk	■		Co
Caprimulgus parvulus	Little Nighthawk	■		Pc
Hydropsalis brasiliana	Scissor-tailed Nightjar	■		Co
Chlorostilbon aureoventris	Festive Coquette	■		Co
Hylocharis chrysura	Gilded Sapphire	■		Co
Cinclodes fuscus	Bar-winged Cinclodes		■	Co
Camptostoma obsoletum	Southern Tyrannulet	■		Co
Elaenia parvirostris	Small-billed Elaenia	■		C
Polystictus pectoralis	Bearded Tachuri	■		Ra
Myiophobus fasciatus	Bran-coloured flycatcher	■		Co
Empidonax euleri	Euler's Flycatcher	■		Ra
Pyrocephalus rubinus	Vermilion flycatcher	■		C
Neoxolmis rufiventris	Chocolate-vented Tyrant		■	Ra
Muscisaxicola macloviana	Dark-faced Ground-Tyrant		■	Ra
Lessonia rufa	Rufous-backed Negrito		■	Co
Hirundinea ferruginea	Cliff Flycatcher	■		Pc
Myarchus swainsoni	Swainson's Flycatcher	■		Co
Myiodynastes maculates	Streaked Flycatcher	■		Co
Empidonomus auratioatrocristatus	Crowned Slaty-Flycatcher	■		Pc
Empidonomus varius	Variegated Flycatcher	■		C
Tyrannus melancholicus	Tropical Kingbird	■		C
Tyrannus savana	Fork-tailed Flycatcher	■		C
Pachyramphus polycopterus	White-winged Becard	■		Co
Tachycineta leucorhoa	White-rumped Swallow	■		C
Progne chalybea	Gray-breasted Martin	■		C
Progne modesta	Southern Martin	■		Ra
Progne tapera	Brown-chested Martin	■		C
Notiochelidon cyanoleuca cyanoleuca	Blue-and-white Swallow	■		C
Notiochelidon cyanoleuca patagonica	Blue-and-white Swallow		■	C
Alopochelidon fucata	Tawny-headed Swallow	■		Co
Stelgidopteryx ruficollis	Rough-winged Swallow	■		Co
Hirundo rustica	Barn Swallow	■		Pc
Petrochelidon pyrrhonota	Cliff Swallow	■		Pc
Sporophila caerulescens	Double-collared Seedeater	■		Pc
Sporophila cinnamomea	Chestnut Seedeater	■		Pc
Cyanoloxia glaucocaerulea	Indigo Grossbeak	■		Pc
Geothlypis aequinoctialis	Masked Yellowthroat	■		Co
Vireo olivaceus	Red-eyed Vireo	■		Co

Appendix 3: Amphibians and reptiles of the plantation landscape

Table 51: **Amphibians in the plantation landscape**

Taxon	Common name	Record in Collection	RECA	IUCN Global	IUCN Regional	Expected Presence	Notes
Chthonerpeton indistinctum	Cecilia		SA	LC	DD	X	Specimen not from Uruguay
Hypsiboas pulchellus		X	LC	LC	LC		
Dendropsophus minutus	Lesser Tree-frog		A	LC	LC	X	Inferred
D. sanborni		X	LC	LC	LC		
Pseudis minuta		X	LC	LC	LC		
Scinax aromothyella			NE	NE	NE	X	Inferred
S. berthae	Dwarf Snout Tree-frog		T	LC	LC	X	Inferred
S. fuscovarius			T	LC	LC	X	Inferred
S. granulatus		X	LC	LC	LC		
S. uruguayus		X	T	LC	LC		
S. squalirostris		X	LC	LC	LC		
Phyllomedusa iheringii		X	T	LC	LC		
Leptodactylus gracilis	Striped Frog	X	LC	LC	LC		
L. latinasus	Oven Frog	X	LC	LC	LC		
L. mystacinus	Moustached Frog	X	LC	LC	LC		
L. ocellatus	Criolla Frog	X	LC	LC	LC		
Physalaemus biligonigerus	Weeping Frog	X	LC	LC	LC		
P. gracilis		X	LC	LC	LC		
P. henselii	Hensel's Dwarf Frog	X	LC	LC	LC		
P. riograndensis		X	LC	LC	LC		
Pleurodema bibroni	Four-eyed Frog		T	NT	NT	X	Inferred
Pseudopaludicola falcipes	Dwarf Frog	X	LC	LC	LC		
Odontophrynus americanus		X	LC	LC	LC		
Limnomedusa macroglossa		X	LC	LC	LC		
Chaunus achavali			T	NE		X	Inferred
C. arenarum			LC	LC	LC	X	Inferred
C. dorbignyi		X	**	LC	**		
C. fernandezae		X	**	LC	**		
Melanophryniscus atroluteus	Redbelly Toad	X	LC	LC	LC		
M. devincenzii			T	EN	EN	X	Inferred
M. sanmartini			SP	NT	NT	X	Inferred
M. pachyrhynus			NE	DD	NE	X	Inferred
Elachistocleis bicolor		X	LC	LC	LC		

AMPHIBIANS –T: threatened, SA: special attention; CR: critical risk; DD: data deficient; EN: endangered; LC: least concern; NT: near threatened; VU: vulnerable, NE: not evaluated. Taxa with * should be considered as data deficient. ** indicates that the species were studied as a group in the genre (*Chaunus* aff. *granulosus*)

Table 52: **Reptiles in the plantation landscape**

Taxon	Common name	Record in Collection	RECA	IUCN Global	IUCN Regional	Expected Presence	Notes
Trachemys dorbignyi	Brazilian Slider	X					
Acanthochelys spixii	Spiny Neck Turtle	X		NT			
Hydromedusa tectifera	Snake-necked Turtle	X					
Phrynops hilarii	Side-necked Turtle	X					
Phrynops williamsi	Williams' Side-necked Turtle					X	Inferred
Caiman latirostris	Broad-snout Caiman			LC		X	Confirmed observation
Anisolepis undulatus	Wiegmann's Tree Lizard		VU	VU		X	Inferred
Liolaemus wiegmanii	Sand Lizard	X	LC				
Stenocercus azureus		X	VU				
Homonota uruguayensis		X	LC				
Amphisbaena darwinii	Darwin's Worm Lizard	X	LC				
A. munoai	Chica	X	LC				
Anops kingii	Keel-headed Worm Lizard	X	LC				
Cnemidophorus lacertoides	S. American Teiid Lizard	X	LC				
Teius oculatus		X	LC				
Tupinambis merianae	Tegu Lizard	X	LC				
Cercosaura schreibersii		X	LC				
Mabuya dorsivittata		X	LC				
Ophiodes aff. *Striatus*		X	LC				
O. vertebralis	Jointed Worm Lizard	X	LC				
Leptotyphlops munoai		X	PC				
Bothrops alternatus		X	LC				Dangerous
B. pubescens		X	LC				Dangerous
Chironius bicarinatus			MC			X	Inferred
Tantilla melanocephala	Black-head Snake		CP ?			X	Inferred presence
Calamodontophis paucidens				VU		X	Inferred presence
Taeniophallus occipitalis	Jan's Forest Snake		CP			X	Inferred presence
T. poecilopogon	Cope's Forest S.		MC			X	Inferred
T. hypoconia		X	LC				
T. strigatus			CP			X	Inferred
Tomodon ocellatus		X	LC				
Boiruna maculata		X	CP				
Clelia rustica	Brown Mussurana		CP			X	Inferred
Helicops infrataeniatus			CP			X	Inferred
Liophis almadensis		X	CP				
Liophis anomalus		X	LC				
Liophis flavifrenatus		X	CP				
Liophis jaegeri		X	LC				
Liophis semiaureus		X	LC				
Liophis poecilogyrus		X	LC				

Taxon	Common name	Record in Collection	RECA	IUCN Global	IUCN Regional	Expected Presence	Notes
sublineatus							
Lystrophis dorbignyi		X	LC				
Lystrophis histricus			MC			X	Inferred
Oxyrhopus rhombifer rhombifer		X	LC				
Phalotris lemniscatus		X	CP				
Philodryas aestiva		X	LC				
P. olfersii olfersii			CP			X	Inferred
P. patagoniensis		X	LC				
Pseudablabes agassizii		X	MC				
Psomophis obtusus		X	LC				
Micrurus altirostris	Southern Coral Snake	X	CP				Dangerous

REPTILES – NT: near threatened; LC: Least Concern; VU: Vulnerable; PC: conservation priority, MC: maximum conservation priority

Appendix 4: People interviewed in the local stakeholder analysis

La Paloma
Pablo Langone: secretary of Local Mayor
Julián Lamadrid: retired ex secretary of mayor
Héctor María Hernández: mechanic
Carlos Alvariza: Magistrate
Carmelita Selhay: Dir. of Secondary School
Shirley del Pino: temporary forestry worker

Dogomar Rivas: contractor, shearing and truck driving
Teresa Hernández: teacher
Blanquillo
Hugo Núñez: secretary of local Mayor
María Glora Albes: representative of the local crafts cooperative
Wilson Tabaré Santana: bar keeper
Eber Umpierrez: merchant

Carina Soca de Umpierrez: housekeeper

Liliana Sosa: teacher
Anibal.Miñaur: cattle dealer
Villa Carmen
Petrona Iris Remedios: teacher and social worker
Luis Iturria: secretary of local Mayor
Silvia D´Avis: Public employee, sweeper

Valeria Santos: Public employee, sweeper

Sergio González: temporary forestry worker.
Daniel Milán: temporary forestry and construction worker.
Padre Gregorio Rodríguez: priest
. Julio César Etcheverry: bee keeper
Amado Dante López: public employee works with Rural studios
Pedro Soust: Ing. Agr Owner of a Nursery, local politivian
Pedro González: Grape Producer Director of Vitis Center, Vinos del Carmen
Gladis Santiago de Gonzales: Integrate social, promotion and devt. group work
Paso de los Toros
Dr. Otormin: secretary of local Mayor
Carmen Gambeta: social worker
Wilson Malseñido: environment director of the Local Mayor.
Jorge Rodríguez Labruna: ex politician of Partido Nacional
Alvaro Silveira: cattle dealer, treasurer of the Rural Association of Paso de los Toros
Washington Aizpún: cattle dealer. amateur archaeologist.
Cristina Coture: Association of Isabelinas
Teresa Varela de Association of Isabelinas

Irineo Pérez: Pte of Rotary Club. Business man with transport company.
Administrator of Charrúa Neighborhood: Olga Antúnez, Teresa Spanga, Mirian Pérez, Jorge Flores, Ester Cáseres, Beatriz Viera
Pueblo Centenario
Sr. Denis: Secretary of loval mayor
Hugo Revelo: rural producer

Clara

Manuel Cortés: businessman and merchant

Clara continued
Daniela Cardozo: merchant
Elida Cuadraro: merchant
Antonio Almeida: rural worker
Zamora
Juan Méndez truck driver
Solano Colinas: employee of rural business, buys cattle
Roberto Caetano: rural business employee

Julio Viera Rodríguez: medium-sixed farm
Mariana ¿?: employee
Daniel Sampayo: secretary of local Mayor
María Isabel Barcia: tourist

Hugo Fierro: retired air controller
Charles Cuadrado fisherman (Secretary Copehum)
José Mendez Ortiz fisherman (President of Copehum Cooperative)
Jorge Fitzgerald Cuadrado: fisherman
Juan Carballo: raftman MTOP.
Ramoncita Rienzo: nurse
Juan Domingo Silva Teacher politician & intellectual
Juan Silva: manager of Radio Ibirapitá
Dra. Anayde Lena: Director of Auxiliary health centre
Segundo Ademar Muga Prieto: oldest Merchant of San Gregorio
Federico Godoy: waiter, forestry worker.
José Antonio Pereira: Journalist Public employee.
Ricardo Lopez Laxalde: cattle dealer
Carlos Larregui: artist.
Bernardo Ruete: vet, small farmer and bee keeper
Adrián Fernández temporary fores worker

Grecco

Carolina Elhordoy: secretary of local Mayor.

Marta Etchebarne: school director.
María Inés Angelo: merchant
Seferino Miño: young man
Edgardo Vasella employee of local mayor.

Alvaro Vidal: employee of local mayor

Richard Vega: repairs

Guichón

Angela Núñez president of local Mayor
Danny Silveira Fiure secretary of local Mayor
Pablo Valdez: member of the commotion of the cemetery of Guichón.
Dr Eduardo Urruti Vet: President of association for work of Guichón

José Texeira: forestry employee.
Niní Gonzales: merchant employee.
Luis María Frugoni: public employee.
José Vigo: foreman of the Corralón Municipal.
Víctor Puentes: gas station employee
Emilia Novo: employee

Appendix 5: People interviewed in the national stakeholder analysis

Institution	Contact	Chosen	Interview
National authorities			
Sub-secretary MGAP	Ing. Agr. Ernesto Agazzi	YES	Did not accept
General Bureau of Forestry. MGAP	Director Ing. Agr. Andrés Berterreche	YES	YES
OPYPA – MGAP	Director Ing. Agr. Martín Buxedas	YES	YES
National Bureau of Employment. MTSS	Director Sara Paysee.	YES	YES
Labor and Social Security General Inspection. MTSS	Director María Narducci.	YES	YES
National Bureau of Environment. MVOTMA	Ing. Agr. Alicia Torres. (with Counselor Luis Sayagues)	YES	YES
National Bureau of Industry. MIEM	Ing. Agr. Carlos Blasi (Representing MIEM)	YES	YES
DINACYT/PDT – MEC	Dr. Amílcar Davyt	NO	NO
Producers' associations			
Association of Forestry Producers.	Gte. Ing. Agr. Edgardo Cardozo – [Manager] and Gte. Andrea Regusci [Technical Manager]	YES	YES
Uruguayan Association of Agronomists.	Pte. Ing. Agr. Enrique Estol [President, Agronomist]	YES	YES
Association of Forestry Contractor Companies in Uruguay	Ex. Pte. José Lestido [Former President]	YES	YES
Association of wood and derivatives workers in Uruguay	Pte. Delfino Álvarez [President]	NO	NO
Rural Association of Uruguay	Pte. Ing. Agr. Guzmán Tellechea Otero [President, Agronomist]	NO	NO
Syndicate of Forestry Workers		NO	NO
Academics and field researchers			
National Programme Forestry Production Research. INIA	Director Ing. Agr.(Ph.D) Zohra Bennadji [Agronomist]	YES	YES
Forestry Unit. School of Agronomy. University of the Republic	Director Ing. Agr. Luis Soria [Agronomist]	YES	YES
School of Social Sciences.	Dean Diego Piñeyro	YES	Did not accept
School of Economics-Institute of Economics.	Agricultural and Industrial Area - Juncture	NO	NO
School of Science.	Dean Julio Fernández	YES	Did not confirm
CIEDUR	Ing. Agr. Pérez Arrarte [Agronomist]	YES	YES
Public-private			
National Institute of Technical Regulations [UNIT]		NO	NO
LATU – [Uruguayan Technological Laboratory]	Ing. Quím. Raúl de Castro [Chemist Engineer]	NO	NO
Institute for Promoting Investment and Exports		NO	NO
Provincial stakeholders			
Commercial Unit of Durazno		YES	Not fixed
Durazno Borough Hall	Chief. Carmelo Vidalín	YES	YES
Tacuarembó Borough Hall	Sec. Gral. José Menéndez	YES	YES
Development Agency of Tacuarembó]	Ing. Agr. Gustavo Ferreira [Agronomist]	YES	YES
CLAEH Tacuarembó	Ing. Agr. Daniel Cal [Agronomist]	YES	YES

Appendix 6: Interview guidelines for national stakeholder analysis

Interviews were based around the following issues:

General aspects of national forestry policy:

- ✓ Do you know about the national forest development strategy? If so, what are its main components?
- ✓ Do you believe there is an alternative forestry model to the one that is being currently implemented? What features would it have?
- ✓ Do you know about any concrete actions that are being or should be carried out to achieve a national forestry scenario integrated with the economy?

Specific aspects of national forestry policy

- ✓ What is your opinion about the repeal of Decree 330/90 by the government? Do you think it promotes a new national forestry policy for the country?
- ✓ What do you think about the integration of forestry workers to the negotiations of the Board of Salaries and the meetings of the three parties [Government, Businessmen and Workers]? What concrete progress do you believe it achieves in the sector?
- ✓ What impact do you think the incentives to forestry have on the collection of the Borough Halls in rural areas?
- ✓ Do you believe that the state is able to assess and follow the environmental impact of forestry?, what does it count on and what does it need?

Vision of the forestry sector in relation to other activity sectors

- ✓ What is your vision of forestry in relation to agricultural and livestock sectors?
- ✓ What is the role of big companies in the development of the forestry sector? What opportunities do the national (and local) companies have?
- ✓ Do you think they are integrated with respect to other national stakeholders? What do you think about it? What conditions are needed to move towards complementarity among the different productive sectors?
- ✓ What is your vision of the labour market in the forestry sector, the relationship among the primary stages, industry and services (squads, subcontracts, sawmills)? From your point of view, how would the labour requirements evolve? Which skills are necessary for this sector?

Assessment and future vision

- ✓ What expectations does the population have regarding forestry development?
- ✓ What is your opinion about the process of forestry in Uruguay? (Mention at least 3 positive and 3 negative aspects of the evolution of this sector):
  - ✓ In the primary stage, what are the economic stakeholders involved? Which are the main benefits and costs of the sector?
  - ✓ What are the main impacts on the environment in the primary stage?
- ✓ Regarding the social impact, could you mention at least 3 positive and 3 negative aspects of the plantations?
- ✓ At present, what is the main technological demand in the sector?
- ✓ What type of research do academics believe the sector has to carry out?
- ✓ What is your vision for development of the sector in the future? (Year 2020)

Specific questions relating to the Stora Enso operation

- ✓ What risks do big companies run when setting up in a region or locality? What things need to be noted and what action is required?
- ✓ What aspects does the company need to strengthen to exert a positive impact on the region as well as on the country?

Appendix 7: Forestry codes of practice

Advice for Stora Enso was compiled by drawing on over 50 national or regional codes of practice for forestry in general and specifically for plantations. In addition to the publications sited in the main text, the following codes were consulted.

Adams, P. W. (1996); *Management Planning: Oregon's Forest Practice Rules*, Oregon State University Extension Service, Corvallis

Alabama Forestry Commission (1993); *Alabama's Best Management Practices for Forestry*, Alabama Forestry Commission in association with Alabama Department of Environmental Management and US Environmental Protection Agency

Arkansas Forestry Commission (2002); *Arkansas Forestry Best Management Practices for Water Protection*, March 16 2002

California Department of Forest and Fire Protection (2005); *California Forest Practice Rules 2005*, State of California, Sacramento

Conservation Commission of the State of Missouri (1997); *Missouri Watershed Protection Practice*, Missouri Department of Conservation, Jefferson

Department of Sustainability and Environment (2006); Code of Practice for Timber Production – Draft for Public Comment, Victoria Government, Melbourne, Australia

Dykstra, Dennis P and Rudolf Heinrich (1995); *FAO Model Guide of Forestry Practice*, Food and Agricultural Organisation of the United Nations, Rome

Evans, J (1992); *Plantation Forestry in the Tropics*, 2nd edition, Clarendon Press, Oxford

Food and Agriculture Organisation of the United Nations (1976); *Harvesting Man-Made Forests in Developing Countries*, Forestry Department, FAO, Rome

FAO [Food and Agriculture Organisation of the United Nations] (1977); *Planning Forest Roads and Harvesting Systems*, Forestry Department, FAO, Rome

FAO [Food and Agriculture Organisation of the United Nations] (1987); *Appropriate Wood Harvesting in Plantations*, FAO Forestry Paper 78, FAO, Rome

FAO [Food and Agriculture Organisation of the United Nations] (2006); Draft Planted Forest Code, 2nd draft 14 March 2006, FAO, Rome

Forest Owners Conference (2003); *Plantation Design Guidelines*, 12 organisations based in Australia

Forest Safety Advisory Group, (2002); *Forestry Safety Code (Tasmania)*, Hobart

Forest Service (2000); *Code of Best Forest Practice* – Ireland, Dublin

Forestry Division (2004); *Best Management Practices for Forestry in Montana*, Department of Natural Resources and Conservation, Missoula

Furneaux, Barry (1993); *Maintenance of Plantation Roads and Bridges*, Timber Plantation Project ABD Loan Number 1000-INO, Ministry of Forestry, Directorate General of Reforestation and Land Rehabilitation, Directorate for Timber Estates

Garland, John J. (1996); *Best Management Practices to Protect Water Quality*, Sustainable Forestry Initiative Programme, American Forest and Paper Association, Washington DC

Georgia Environmental Protection Division (1999); *Georgia's Best Management Practices for Forestry*, Georgia Environmental Protection Division, the Georgia Forestry Commission, and the Georgia Forestry Association, Talanta

Hartshorn, G S (1983); Ecological implications of tropical plantation forestry, in **R Sedjo** [editor], *The Comparative Economics of Plantation Forestry: A Global Assessment*, Resources for the Future, Washington DC

ILO [International Labour Organisation] (1998); *Safety and Health in Forestry Work*, ILO, Geneva

ITTO [International Tropical Timber Organisation] (1992); *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*, ITTO Policy Development Series **1**, ITTO, Yokohama, Japan

Kittredge, David B. Jnr. and Michael Parker (1999); *Massachusetts Forestry Best Management Practices Manual*, Massachusetts Department of Environmental Protection and the US Environmental Protection Agency, Boston

Korhonen, Kirsi-Marja [editor] (1998); *Environmental Guidelines for Practical Forest Management*, Metsähallitus Forest and Park Service, Vantaa

Lindenmayer, David B. (2002); *Plantation Design and Biodiversity Conservation, A report for the RIRDC/ Land and Water Australia/ FWPRDC, Joint Venture Agroforestry Programme*, RIRDC Publication number 02 01 9, Rural Industries Research and Development Corporation, Barton

Long, Alan J. (2006 (revised edition first published 1994); *Environmentally Sound Harvesting*, University of Florida IFAS Extension, Paper SS-FOR-6, Gainesville

Louisiana Department of Forestry, Louisiana Department of Environmental Quality, Louisiana Forestry Association (2000); *Recommended Forestry Best Management Practices for Louisiana*, Baton Rouge

Maryland Department of Natural Resources Forest Service (undated); *Best Management Practices for Forest Harvests*, accessed at http://www.dnr.state.md.us/forests/landplanning/bmp.html, on 12 January 2007

Michael, Jerry L. (2004); Best Management Practices for Silvicultural Chemicals and the Science Behind Them, *Water, Air and Soil Pollution: Focus* **4**: 95-117

Minnesota Forest Resources Council (2005); *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers*, Minnesota Forest Resources Council, St Paul

Mississippi Forestry Commission (2004); *The Forest Landowner and Water Quality*, MFC Publication number 104, Jackson, accessed at http://www.mfc.state.ms.us/pdf/MFC104.htm on 12th January 2007

Moesswilde, Morten (undated); *Best Management Practices for Forestry: Protecting Maine's Water Quality*, Department of Conservation, Maine Forest Service, Augusta

Moesswilde, Morten edited by Sarah Smith (2005); *Best Management Practices for Forestry: Protecting New Hampshire's Water Quality*, University of New Hampshire Cooperative Extension, Concord (edited version of the Maine document)

Muhtaman, D.R., C.A. Siregar, and P. Hopmans (2000); *Criteria and indicators for sustainable plantation forestry in Indonesia, Center for International Forestry Research*, Bogor, Indonesia

New Zealand Forest Owners' Association (undated); Principles for Plantation Forest Management in New Zealand, Wellington, Accessed at http://www.nzfoa.org.nz/file_libraries/agreements_accords/principles_for_commercial_plantation_forest_management_in_new_zealand on 12th January 2007

New York State (undated); *New York State Timber Harvesting Guidelines*, New York State Department of Environmental Conservation, the New York Society of American Foresters, and the College of Environmental Science and Forestry

North Carolina Division of Forest Resources (2006 revised edition); *North Carolina Forestry Best Management Practices Manual*, Publication number FM-08-01

Northern Ireland Forest Service (undated); *Environmental Guidelines for Timber Harvesting*, Belfast

Ohio (undated); *BMPs for Erosion Control for Logging Practices in Ohio*, Bulletin 196, Columbus

Persson, Jerker (1990); *A Richer Forest*, The National Board of Forestry, Jönjöping

Phillips, Michael J. (1997); Forestry best management practices for wetlands in Minnesota, in Northern Forested Wetlands Ecology and Management, [edited by] Carl C. Trettin, Martin F. Jurgensen, David F. Grigal, Margaret R. Gale, and John K. Jeglum, CRC Press

Poore, M E D (1993); *Guidelines: Shell/WWF Tree Plantation Review*, Shell International Petroleum Company Ltd and WWF UK

Richard, B N (1993); *Guidelines for Site Classification and Determination of Fertilizer Requirements of Industrial Forest Plantations*, Asian Development Bank, October 1993

Sankar, C., P.C. Anil, and M. Amruth (2000); *Criteria and Indicators for Sustainable Plantation Forestry in India*, Center for International Forestry Research, Bogor, Indonesia

Sawyer, Jacqueline (1994); *Plantations in the Tropics: Environmental Concerns*, IUCN Forest Conservation Programme, IUCN, Gland

Sedlak, O (1988); *Principles of Forest Road Nets*, Food and Agriculture Organisation of the United Nations, Rome

Sedlak, O (1988); *Maintenance of Forest Roads*, Food and Agriculture Organisation of the United Nations, Rome

Sedlak, O (1994); Forest harvesting and environment in Austria, paper presented at the Meeting of Experts on Forest Practices, FAO, Rome

South Carolina Forestry Commission (1994); South Carolina's Best Management Practices for Forestry;

Stringer, Jeffrey W. and Cary Perkins (2001); *Kentucky Forest Practice Guidelines for Water Management*, Cooperative Extension Service, University of Kentucky, Lexington

Terri Wildermuth (2002); *New Mexico Forest Practices Guidelines*, Energy, Minerals and Natural Resources Department – Forestry Division, New Mexico State Forestry, Santa Fe

Texas Forest Service and Texas Forestry Association (2004); *Texas Forestry Best Management Practices*, Lufkin

Virginia Department of Forestry (2002 – 4th edition); *Virginia Forestry Best Management Practices for Water Quality*, Richmond

Visser, Rien (1994); New Zealand forestry and the forest code of practice, paper presented at the Meeting of Experts on Forest Practices, FAO, Rome

References

Abellán, P., D. Sánchez-Fernández, J. Velasco and A. Millán. 2004. Selección de áreas prioritarias de conservación en la provincia de Albacete utilizando los coleópteros acuáticos. Instituto de estudios albacetenses "Don Juan Manuel". Serie I-Estudios- Nº 151: 157pp

Achaval, F. 2007. Listas de especies de vertebrados de Uruguay. http://zvert.fcien.edu.uy. Accessed 8th February 2007

Achaval, F., M. Clara and A. Olmos. 2004. *Mamíferos de la República Oriental del Uruguay: Una guía fotográfica*. 174 pp

Aldrich, M., A. Belokurov, J. Bowling, N. Dudley, C. Elliott, L. Higgins-Zogib, J. Hurd, L. Lacerda, S. Mansourian, T. McShane, D. Pollard, J. Sayer and K. Schuyt. 2003. Integrating Forest Protection, Management and Restoration at a Landscape Scale. WWF International, Gland, Switzerland

Altesor, Alice, Martín Oesterheld, Elsa Leoni, Felipe Lezama and Claudia Rodríguez. 2005. Effect of grazing on community structure and productivity of a Uruguayan grassland. *Plant Ecology* **179** (1): 83-91

Altesor, A., G. Piñeiro, F. Lezama, R. B. Jackson, M. Sarasola and J. M. Paruelo. 2005. Ecosystem changes associated with grazing in subhumid South American grasslands, *Journal of Vegetation Science* **17**: 323-332

Amis, L., P. Brew, and C. Ersmarker. 2005. *Human Rights: It's Your Business – The Case for Corporate Engagement,* The Prince of Wales International Business Leaders Forum. Available at http://www.iblf.org/docs/ItIsYrBusiness.pdf (Accessed 1 May, 2007)

Amnesty International. 2005. *Human rights for human dignity: A primer on economic, social and cultural rights,* Amnesty International Publications - International Secretariat, London

Andreassian, V., 2004. Water and forests: from historical controversy to scientific debate. *Journal of Hydrology* **291**: 1-27

Anon. 1999. *International Experts Meeting on the Role of Planted Forests in Sustainable Forest Management*, Santiago Chile 6-10 April 1999, Ministry of Agriculture, Santiago Chile

Anon. Undated (a). *Mission, Vision and Values*. Sora Enso

Anon. Undated (a). *Stora Enso's principles for the development of forest certification*. Stora Enso

Aracruz. 2002. *Projecto Monitoramento de Microbacia; Relatorio anual das atividades realizadas em 2001*. Aracruz Celulose, Aracruz, Brazil

Aracruz. 2003. *Social and Environmental Report*. Aracruz Celulose, Aracruz, Brazil

Araya, E.M. 2000. Colonización de sustratos artificiales por macroinvertebrados bentónicos en un ecosistema fluvial de baja intervención antrópica, Estero Nonguén (VIII Región, Chile). Tesis de Magíster en Zoología. Facultad de Ciencias Naturales y Oceanográficas. Universidad de Concepción. 128 pp

ARC Plant Protection Research Institute (undated) http://155.240.199.39/institutes/ppri/main/divisions/weedsdiv/current_research_state.htm (accessed 6th August 2007)

Astrid, L., R. Riveros, F. Gast and P. von Hilderbrand. 2003. Escarabajos coprófagos (Coleoptera: Scarabaeidae: Scarabaeinae) del Parque Nacional Natural "Serranía de Chiribiquete", Caqueta, Colombia, (Parte I). In Onore, G.; P. Reyes and M. Zunino (eds.) Escarabeidos de Latinoamérica: Estado del Conocimiento (3): 51-58

Australian Government Bureau of Rural Sciences. 2003. The impact of forest plantations on water yield: a statement clarifying key scientific issues. Also supported by CSIRO, Murray Darling Basin Commission and Co-operative Research Centre fir Catchment Hydrology

Ayling, R. and K. Kelly. 1997. Dealing with conflict: natural resources and dispute resolution. *Commonwealth Forestry Review* **76** (3): 182–185

Baguette, M., B. Deceuninck, and Y. Muller. 1994. Effects of spruce afforestation on bird community dynamics in a native, broad-leaved forest area. *Acta Oecologica* **15**: 275-288

Baldi, G., J. P. Guerschmann and J. M. Paruelo. 2006. Characterizing fragmentation in temperate South America grasslands. *Agriculture, Ecosystems and Environment* **116**: 197-208

Barbaro, L., J-P. Rossi, F. Vetillard, J. Nezan and H. Jactel. 2007. The spatial distribution of birds and carabid beetles in pine plantation forests: the role of landscape composition and structure. *Journal of Biogeography* **34** (4): 652–664

Bazett, M. 2000. *Public Incentives for Industrial Tree Plantations*. WWF and IUCN, Gland, Switzerland

Behling, Hermann, Valerio DePatta Pillar and Soraia Girardi Bauermann. 2005. Late Quaternary grassland (Campos), gallery forest, fire and climate dynamics, studied by pollen, charcoal and multivariate analysis of the São Francisco de Assis core in western Rio Grande do Sul (southern Brazil). *Review of Palaeobotany and Palynology* **133**: 235-248

Benyon, R. G. and T. M. Doody. 2004. *Water Use by Tree Plantations in South East South Australia.* CSIRO Forestry and Forest Products, Mt Gambier

Berazategui, M., A. Camargo and R. Maneyro. In press. Environmental and seasonal variation in the diet of *Elachistocleis bicolor* (Guérin-Méneville 1838) (Anura: Microhylidae) from northern Uruguay. *Zoological Science*

Berden, M, I, Nilsson, K, Posen and G, Tyler. 1987. *Soil Acidification: Extent, Causes and Consequences*, Report 3292, National Swedish Environmental Protection Board, Solna

Bernhard-Reversat, F (ed). 2001. *Effect of Exotic Tree Plantations on Plant Diversity and Biological Soil Fertility in the Congo Savanna: With Special Reference to Eucalypts.* CIFOR, Bogor, Indonesia

Bibby, C. J., Aston, N. and Bellamy, P. E. 1989. Effects of broad-leaved trees on birds of upland conifer plantations in north Wales. *Biological Conservation* **49**: 17–29

Bildstein, K. and K. Meyer. 2000. Sharp-shinned hawk (Accipiter striatus). *In*: A. Poole, F. Gill, (eds.) *The Birds of North America*, No. 482. Philadelphia, PA: The Birds of North America, Inc

Biodiversity Planning Support Programme. 2001. *The Integration of Biodiversity into National Environmental Assessment Procedures: National Case Studies: Uruguay*. UNDP / UNEP / GEF

Binkley, D. 2001. *Patterns and Processes of Variation in Nitrogen and Phosphorus Concentrations in Forested Streams*. Technical Bulletin number 836. National Council for Air and Stream Improvement, Triangle Park, NC, USA

Binkley, D., H Burnham and H. L. Allen. 1999. Water quality impacts of forest fertilization with nitrogen and phosphorus. *Forest Ecology and Management* **121**: 199-213

Binkley, D., R. Carter and H. L. Allen. 1995. Nitrogen fertilization practices in forestry. In: *Nitrogen Fertilization in the Environment*. (ed.) P. E. Bacon. Marcel Dekker, New York, Basel and Hong Kong

Binkley, D. and J. L. Stape. 2004. Sustainable management of eucalyptus forest in a changing world. In Borralho, N., *et al.* (2004). Eucalyptus in a Changing World. Proc. of IUFRO Conf., Aveiro 11-15 October 2004

Binkley, D., J. L. Stape and M. G. Ryan. 2004. Thinking about efficiency of resource use in forests. *Forest Ecology and Management* **193**: 5-16

Bol, M. M. G. R. and F. Beekman. 1989. *Economically and Environmentally Sound Harvesting Methods*. Norwegian Forest Resource Institute

Bohan, D. A., C. W. H. Boffey, D. R. Brooks, S. J. Clark, A. M. Dewar, L. G. Firbank, A. J. Haughton, C. Hawes, M. S. Heard, M. J. May, J. L. Osborne, J. N. Perry, P. Rothery, D. B. Roy, R. J. Scott, G. R. Squire, I. Woiwood, and G. T. Champion. 2005. Effects of weeds and invertebrate abundance and diversity of herbicide management in genetically modified herbicide-tolerant winter-sown oilseed rape. *Proceedings of the Royal Society B*. **272**: 463–474

Boothroyd, I.K.G., J.M. Quinn, E.R. Langer, K.J. Costley, and G. Steward. 2004. Riparian buffers mitigate effects of pine plantation logging on New Zealand streams - 1. Riparian vegetation structure, stream geomorphology and periphyton. *Forest Ecology and Management* **194** (1-3): 199-213

Bosch, J.M. and J.D. Hewlett. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. *Journal of Hydrology* **55**: 3-23

Bournard, M., P.Richoux and P. Usseglio-Polaterra. 1992. An approach to the synthesis of qualitative ecological information from aquatic coleoptera communities. *Regulated Rivers: Research and Management* **7**:165-180

Bowling, J. 2000. A workers view of sustainable forestry. In: von Gradow, K. T. Pukkala and M. Tome (eds.). *Sustainable Forest Management*. Netherlands

Bowyer, J. L. 2001. Environmental implication of wood production in intensively managed plantations. *Wood and Fiber Science* **33**: 318-333

Boyd, R. S., J. D. Freeman, J. H. Miller and M. Boyd Edwards. 1995. Forest herbicide influences on floristic diversity seven years after broadcast pine release treatments in central Georgia, USA. *New Forests* **10** (1): 17-37

Brockerhoff, E. G., L. A. Berndt and H. Jactel. 2005. Role of exotic pine forests in the conservation of the critically endangered New Zealand ground beetle *Holcaspis brevicula* (Coleoptera, Carabidae). *New Zealand Journal of Ecology* **29** (1): 37-43

Brown, A.E., L. Zhang, T. A. McMahon, A. W. Western, R. A. Vertessy. 2005. A review of paired catchment studies for determining changes in water yield resulting from alterations in vegetation. *Journal of Hydrology* **310**: 28-61

Brown, S., E. Palola, and M. Lorenzo. 2006. *The Possibility of Plantations*: *Integrating Ecological Forestry into Plantation Systems.* National Wildlife Federation, VA, USA

Bull, G. Q., M. Bazett, O. Schwab, S. Nilsson, A. White and S. Maginnis. 2005. Industrial forest plantation subsidies: Impacts and implications, *Forest Policy and Economics* **9** (1): 13-31

Bureau of Rural Sciences. 2005a. *Socio-economic Impacts of Plantation Forestry in the Great Southern Region (WA)*. Australian Government: Forest and Wood Products Research and Development Division

Bureau of Rural Sciences. 2005b. Socio-economic Impacts of Plantation Forestry in the Southwest Slopes Region (NSW). Australian Government: Forest and Wood Products Research and Development Division

Burrough, E. R. Jr. and J. G. King. 1989. *Reduction in Soil Erosion on Forest Roads*. United States Department of Agriculture Forest Service. General Technical Report INT-264, Ogden, Utah

Butterfield, J. and J. B. Malvido 1992. Effect of mixed-species tree planting on the distribution of soil invertebrates. In: M. G. R Cannell, D. C. Malcolm and P. A. Robertson (eds.). *The Ecology of Mixed Species Stands of Trees*. Blackwell Scientific Publications, Oxford: 255–265

Cabarle, B., N. Brown and K. Cesaro. 2005. Integrating protected areas, plantations and certification. *Journal of Sustainable Forestry* **21** (4): 15-32

Calder, I. R. 1986. A stochastic model of rainfall interception. *Journal of Hydrology* **89**: 65–71

Calder, I. 1992. Water use of eucalypts—A review. In I. Calder, R. Hall, and P. Allard (eds.) *Growth and water use of forest plantations*. John Wiley & Sons, New York, NY: pp 167-179

Calder, I. R. 2002. Forests and hydrological services: reconciling public and science perceptions, *Land Use and Water Resources Research* **2**: 2.1-2.12

Calder, I., M. Swaminath, G. Kariyappa, N. Srinivasalu, K. Srinivasa Murthy and J. Mumtaz. 1992. Measurements of transpiration from eucalyptus plantations, India, using deuterium tracing. In I. Calder, R. Hall, and P. Allard (eds.) *Growth and water use of forest plantations*. John Wiley & Sons, New York, NY: pp 196-215

Cannell, M. G. R. 1999. Environmental impacts of forest monoculture: water use, acidification, wildlife conservation and carbon storage. *New Forests* **17** (1-3): 239-262

Carlyle, J. C., M. W. Bligh and E. K. S. Nambiar. 1998. Woody residue management to reduce nitrogen and phosphorus leaching from sandy soil after clear-felling *Pinus radiata* plantations, *Canadian Journal of Forestry Research* **28** (8): 1222–1232

Carnus J-M, J. Parrotta, E. G. Brockerhoff, M. Arbez, H. Jactel, A. Kremer, D. Lamb, K. O'Hara K and B. Walters. 2003. "Planted forests and biodiversity". In: Buck A., J. Parrotta and G. Eolfrum (eds.). *Science and Technology-Building the future of the world's forests. Planted forests and biodiversity*. IUFRO Occasional Paper No. 15. IUFRO, Vienna, Austria, pp. 33-49

Carreira, S. and I. Lombardo. In press. *Tomodon dorsatus* (NCN). Distribution. *Herpetological Review*

Carreira, S., M. Meneghel and F. Achaval. 2005. *Reptiles de Uruguay*. DI.R.A.C. Facultad de Ciencias, Universidad de la República, Montevideo, 639 pp

Carrere, Ricardo. 1999. *Plantations Campaign: Ten replies to ten lies*. World Rainforest Movement, Montevideo

Carrere, Ricardo. 2001. *Monte Indígena*. Ediciones de Brecha and Nordan Communidad, Montevideo

Carrere, Ricardo. 2006. Greenwash: *Critical Analysis of FSC Certification in Industrial Tree Monocultures in Uruguay*. World Rainforest Movement, Montevideo

Carrere, Ricardo and Larry Lohmann. 1996. *Pulping the South: Industrial tree plantations and the world paper economy*. Zed Books and The World Rainforest Movement, London and Montevideo

CBD (Convention on Biological Diversity). 2001. *Review of the Efficiency and Efficacy of Existing Legal Instruments Applicable to Invasive Alien Species*. CBD Technical Series number 2. Secretariat of the Convention on Biological Diversity, Montreal

CBD (Convention on Biological Diversity). 2004. *The Ecosystem Approach*. Convention on Biological Diversity and UNEP. Montreal and Nairobi

CBI (Consensus Building Institute). 2005. *Uruguay Pulp Mills Stakeholder Assessment Findings*. The Consensus Building Institute Cambridge MA and Washington DC, USA

Cernea, M. 2006. “Population Displacement Inside Protected Areas: A redefinition of concepts in conservation policies”, in *Policy Matters: Poverty, Wealth, and Conservation,* IUCN Commission on Environmental, Economic, and Social Policy, Issue 14: March 2006

Chapman P. J., A. C. Edwards, B. Reynolds, C. Neal and L. Heathwaite. 1999. *The nitrogen composition of streams draining grassland and forested catchments : influence of afforestation on the nitrogen cycle in upland ecosystems* , IAHS Press, Wallingford, UK

Charnley, S. 2006. Industrial Plantation Forestry: Do Local Communities Benefit? *Journal of Sustainable Forestry* **21** (4)

Chescheir G. M., N. von Stackelberg, D. M. Amatya and R. W. Skaggs. 2004. *Effects of Afforestation on the Hydrologic Behaviorof a Basin in the Tacuarembo River: Progress report*. Submitted to Weyerhauser Foundation from North Carolina State University

Chomitz, K, M, and K, Kumari, 1996, *The domestic benefits of tropical forests: A critical review emphasizing hydrologic functions,* World Bank Policy Research Working Paper, Number 1601, Washington DC

Ciesla, W. M. 1991. Cypress aphid: a new threat to Africa's forests; *Unasylva* **167**:42

CIFOR and IUFRO. 1999. *Biodiversity Conservation in Production Forests*. Center for International Forestry Research and International Union of Forest Research Organisation, Bogor Indonesia and Vienna

Clapham, A. 2006. *Human Rights Obligations of Non-State Actors*. Oxford University Press: New York

Clayton, J. L. 1990. *Soil Disturbance Resulting from Skidding Logs on Granite Soils in Central Idaho.* USDA Forest Service. Research Paper INT-436, Ogden

Clout, M. N. 1984. Improving exotic forests for native birds. *New Zealand Journal of Forestry* **24**:2

Cole, E. C., W. C. McComb, M. Newton, C. L. Chambers, and J. P. Leeming. 1997. Response of amphibians to clearcutting, burning and glyphosate application in the Oregon coast range. *Journal of Wildlife Management* **61** (3): 656–664

Commonwealth of Australia. 1999. *A Study on the Global Outlook for Plantations: Executive Summary*. A technical paper for the Intergovernmental Panel on Forests. Commonwealth of Australia, Canberra

Cossalter, Christian and Charlie Pye-Smith. 2003. *Fast-Wood Forestry: Myths and realities*. Forest Perspectives number 1. Center for International Forestry Research, Bogor Indonesia

Counsell, Simon and Kim Terje Loraas. 2002. *Trading in Credibility: The myth and reality of the Forest Stewardship Council*. The Rainforest Foundation, London and Oslo

Cregg, B., C. Rios, J. Hart, and D. Briggs. 2004. *Fate of Nitrates in Field Nursery Production Systems,* USDA Forest Service Proceedings RMRS-P-33

Croke, J, P. Wallbrink, P. Fogarty, P. Hairsine, S. Mockler, B. McCormack and J. Brophy. 1999. *Managing Sediment Sources And Movement In Forests: The Forest Industry and Water Quality,* INDUSTRY REPORT, 99/11, Australia

CSIRO. Undated. *Development of a Fire Management Strategy for Blue Gum* (Eucalyptus globulus) *Plantations*. http://www.ffp.csiro.au/nfm/fbm/Research/Bluegums.html (accessed 6th August 2007)

Cubbage, F. P. Mac Donagh, J. Sawinski Jnr, R. Rubilar, P. Donoso, A. Ferreira, V. Hoeflich, V Morales Olmos, G. Ferreira, G. Balmelli, J Siry, M. Noemi Báez and J. Alvarez. 2007. Timber investment returns for selected plantations and native forests in South America and the Southern United States. *New Forests* **33** (3): 237-255

Danish Institute for Human Rights. 2006. *HRCA Quick Check Booklet*. Danish Institute for Human Rights' Human Rights and Business Project, August 2006. Available at http://www.humanrightsbusiness.org/020_project_publications.htm (Accessed 1 May, 2007)

De'Nadai, A, Overbeek, W and L A Soares (2005) ; *Promises Of Jobs And Destruction Of Work, The case of Aracruz Celulose in Brazil,* World Rainforest Movement, Montevideo

De Paula Lima, W. Efeitos hidrológicos do manejo de florestas plantadas: 10-28, in De Paula Lima, W. and M. J. B. Zakia (eds.). 2006. *As Florestas Plantadas e a Água*. RiMa Editora

De Paula Lima, W. and M. J. B. Zakia (eds.). 2006. *As Florestas Plantadas e a Água*. RiMa Editora

De Paula Lima, W. and M. J. B. Zakia. 2006a. Saúde Ambiental de Microbacia. In De Paula Lima, W. and M. J. B. Zakia (eds.) *As Florestas Plantadas e a Água*. RiMa Editora

Department of Sustainability and Environment. 2006. Code of Practice for Timber Production – Draft for Public Comment. Victoria Government, Melbourne, Australia

DFID (Department for International Defelopment, UK). 1999. *Sustainable Livelihoods Guidance Sheets,* DFID, UK

Down to Earth. 1991. *Pulping the Rainforest: The rise of Indonesia's paper and pulp industry*. Down to Earth International Campaign for Ecological Justice in Indonesia, Asia Pacific People's Environmental Network, Penang, Malaysia

Duarte, J.M.B. 2001. O Cervo do Pantanal (*Blastoceros dichotomus*) de Porto Primavera. -Resultado de dois anos de Pesquisa. C.D. Rom - Jaboticabal FUNEP-Brasil

Duchesne, L. C., R. A. Lautenschlager, and F. W. Bell. 1999. Effects of clear-cutting and plant competition control methods on carabid (Coleoptera: Carabidae) assemblages in northwestern Ontario. Environmental Monitoring and Assessment **56**: 87–96.

Dudley, N. 1985. *Nitrates in Food and Water*. London Food Commission, London

Dudley, N. 1992. Forests in Trouble: A review of the status of temperate forests worldwide. WWF International, Gland, Switzerland

Dudley, N. 1997. *The Year the World Caught Fire*. WWF International, Gland, Switzerland

Dudley, N. and J-P. Jeanrenaud. 1997a. Needs and prospects for international cooperation in assessing forest biodiversity: an overview from WWF, in *Assessment of Biodiversity for Improved Forest Planning: Proceedings of the Conference on Assessment of Biodiversity for Improved Forest Planning, 7-11 October 1996 in Monte Verità, Switzerland*, European Forest Institute, Proceedings number 18, Kluwer Academic Publishers

Dudley, N., J-P. Jeanrenaud and D. A. Gilmour. 1997b. The role of NGOs in the forest debate. Invited paper at the XI World Forestry Congress, Antalya, Turkey

Dudley, Nigel, Sue Stolton and Jean-Paul Jeanrenaud. 1995. *Pulp Fact: The environmental and social impacts of the pulp and paper industry*. WWF International, Gland, Switzerland

Durkin, P. R. 2003. *Glyphosate - Human Health and Ecological Risk Assessment Final Report Prepared for: USDA, Forest Service Forest Health Protection*, USFS, US

Dykstra, D. P. and R. Heinrich. 1995. *FAO Model Guide of Forestry Practice*. Food and Agricultural Organisation of the United Nations, Rome

Eckholm, Eric. 1975. *The Other Energy Crisis: Firewood*. Worldwatch Paper number 1. Worldwatch Institute, Washington DC

Eckholm, Eric, Gerald Foley, Geoffrey Barnard and Lloyd Timberlake. 1984. *Fuelwood: The energy crisis that won't go away*. Earthscan, London

El-Swaify S. A. 2002. *Impacts of Land Use Change on Soil Erosion and Water Quality—A Case Study from Hawaii*. 12th ISCO conference, Beijing

Elliott, C. 2003. *WWF Vision for Planted Forests*, Keynote paper for the UNFF Intersessional meeting on Planted Forests, New Zealand, March 24-30, 2003

Elliott H. J. and B.S. Hodgson. 2004. Water sampling by Forestry Tasmania to determine presence of pesticides and fertiliser nutrients, 1993–2003. *Tasforests* **15**, June 2004

Escobar, F., 2000. Diversidad de coleópteros coprófagos (Scarabaeidae: Scarabaeinae) en un mosaico de hábitats en la reserva Natural Nukak, Guaviare, Colombia. *Acta Zoológica Mexicana* **79**: 103-121

Estades, C. F. and S. A. Temple. 1999. Deciduous-forest bird communities in a fragmented landscape dominated by exotic pine plantations. *Ecological Applications* **9**: 573-585

European and Mediterranean Plant Protection Organisation. Undated. http://www.eppo.org/QUARANTINE/Alert_List/insects/CTNRST.htm (accessed 6th August 2007)

European Union. 2002. *Review report for the active substance glyphosate. Finalised in the Standing Committee on Plant Health at its meeting on 29 June 2001 in view of the inclusion of glyphosate in Annex I of Directive 91/414/EEC*

Evans, Julian. 1999. *Sustainability of Forest Plantations: The evidence*. Department for International Development, London

Evans, J. and J. W. Turnbull. 2005. (3rd edition). *Plantation Forestry in the Tropics The role, silviculture and use of planted forests for industrial, social, environmental and agroforestry purposes*. Oxford University Press, Oxford. UK

Fahey, B. 1994. The effect of plantation forestry on water yield in New Zealand. *New Zealand Forestry* **39** (3):18-23

Fahey B. and R. Jackson. 1997. Hydrological impacts of converting native forests and grasslands to pine plantations, South Island, New Zealand. *Agricultural and Forest Meteorology* **84**: 69-82

Faithful, J., J. Brodie, C. Armstrong, P. Frayne and K. Bubb.2005.; *Water Quality Of Runoff Draining From Pine Plantation, Native Forest And Agricultural Crops In The Whitfield Creek Catchment, Located In The Wet Tropics Of North Queensland, Australia In The 2003/04 Wet Season*. ACTFR Report No. 05/02, Australia

FAO. 1977. *Planning Forest Roads and Harvesting Systems*. Forestry Department, FAO, Rome

FAO. 1987. *Appropriate Wood Harvesting in Plantations*. FAO Forestry Paper 78. FAO, Rome

FAO. 1992. *Cost Control in Forest Harvesting and Road Construction*. FAO Forestry Paper number 99. FAO, Rome

FAO. 1998. *Forest Resource Assessment 2000 Terms and Definitions*. Forest Resource Assessment Programme Working Paper number 1. Food and Agriculture Organisation of the United Nations, Rome

FAO. 2000. *Global Forest Resources Assessment 2000: Main Report*. FAO Forestry Paper 140. Food and Agricultural Organization of the United Nations, Rome

FAO. 2001. *Global Forest Resources Assessment 2000*. FAO Forestry Paper number 140. Food and Agriculture Organisation of the United Nations, Rome

FAO. 2001. *Biological Sustainability of Productivity in Successive Rotations,* (Based on the work of Julian Evans, Consultant, edited by D. J. Mead). FAO, Rome

FAO. 2005. *Global Forest Resources Assessment 2005: Progress towards sustainable forest management*. FAO Forestry Paper number 147. Food and Agriculture Organisation of the United Nations, Rome

FAO. 2006. Draft Planted Forest Code, 2nd draft 14 March 2006, FAO, Rome

FAO. 2006. *Responsible management of planted forests: voluntary guidelines.* Planted Forests and Trees Working Paper 37/E. Rome (also available at www.fao.org/forestry/site/10368/en). [Need to update ref to draft code above]

Farley, K. A., E. G. Joggáby and R. B. Jackson. 2005. Effects of afforestation on water yield: a global synthesis with implications for policy. *Global Change Biology* **11**: 1565-1576

Favila, M. and G. Halffter. 1997. The use of indicator groups for measuring biodiversity as related to community structure and function. *Acta Zool. Mex*. (*n.s.*):**72**:1-25

Figuero, R., C. Valdovinos, E. Araya and O. Parra. 2003. Macroinvertebrados bentónicos como indicadores de calidad de agua de ríos del sur de Chile. *Revista Chilena de Historia Natural* **76** (2): 275-285

Fontana, C., A. G. Bencke, E. R. Reis. 2003. *Livro vermelho do fauna ameacada de extincao no Rio Grande do Sul. Porto* Alegre. Brasil. 632 p.

Forest Owners Conference (2003); *Plantation Design Guidelines*, 12 organisations based in Australia

Forest Safety Advisory Group. 2002. *Forestry Safety Code (Tasmania)*. Hobart

Forest Service. 2000. *Code of Best Forest Practice – Ireland*. Dublin

Forman, D., S. Al-Dabbagh and R. Doll. 1985. Nitrate, nitrites and gastric cancer in Great Britain. *Nature* **313**: 620-625

Forrester, D. I., J. Bauhus, A. L. Cowie and J. K. Vanclay. 2006. Mixed species plantations of *Eucalyptus* with nitrogen-fixing trees: a review. *Forest Ecology and Management* **233**: 211-230

Frankental, P. and F. House. 2000. *Human rights – is it any of your business?,* Amnesty International UK and The Prince of Wales Business Leaders Forum. Available at http://www.iblf.org/resources/general.jsp?id=81 (accessed 1 May, 2007)

Freudenberger, D. 2006. *Plantation Biodiversity Scorecard*. Ensis (CSIRO and SCION)

Friedman, S. T. 2006. Environmental aspects of the intensive plantation/reserve debate. *Journal of Sustainable Forestry* **14** (21)

Froehlich, H. A., D. E. Aulerich and R. Curtis. 1981. *Designing Skid Trail Systems to Reduce Soil Impacts from Tracked Logging Machines*. Research Paper 44. Forest Research Lab, Corvallis, Oregon

Galli, O. 2004. Uruguay: either with the people or with pulp mills and tree plantations. *World Rainforest Movement Bulletin* **83**: 30-31

Garforth, M. and J. Mayers. 2005. *Plantations, privatisation, poverty and power*. International Institute for Environment and Development, London

Garson, J.; A. Aggarwal and S. Sarkar. 2002. Birds as Surrogates for Biodiversity: An Analysis of a Data Set from Southern Québec. *Journal of BioSciences* **27** (Nº 4, Suppl.2) 347-360

Geary, T. F. 2001. Afforestation in Uruguay: a changing landscape. *Journal of Forestry* **99**: 35-39

Gill, A. M. and J. E. Williams. 1996. Fire regimes and biodiversity: the effects of fragmentation of southeastern Australian eucalypt forests by urbanisation, agriculture, and pine plantations. *Forest Ecology and Management* **85**: 267-278

Girvetz, E.H. and F.M. Shilling. 2003. Decision support for road system analysis and modification on the Tahoe National Forest. *Environmental Management* **32**: 218-233

Global Invasive Species Database. Undated. http://www.issg.org/database/species/search.asp?sts=sss&st=sss&fr=1&sn=&rn=uruguay&hci=-1&ei=-1&x=24&y=13 (accessed 6th August 2007)

Global Invasive Species Initiative. 2005. http://tncweeds.ucdavis.edu/moredocs/pintae01.html (accessed 6th August 2007, information in Spanish and Portuguese)

Global Reporting Initiative: http://www.globalreporting.org/Home

Goncalves, J.L. and J.L. Stape (eds.). 2002. *Conservacao e cultivo de solos para plantacoes florestais*. Instituto de Pesquisas e Estudos Florestais, Piracicaba, Brazil

Gonzalez, S. 2004. Biología y conservación de Cérvidos Neotropicales del Uruguay. Informe Final de Proyecto CSIC-UdelaR, 57pp

González, S., R. Álvarez –Alvarez and J. E. Maldonado. 2004. Técnica molecular para la determinación taxonómica y análisis poblacional en cérvidos neotropicales VI International Conference on Wildlife Management in Amazonia and Latin America: 5- 11 September, Iquitos-Perú

González, S., J. E. Maldonado, J. E. Garcia andJ. M. B. Duarte. 2001. Ecologia e Distribuição de *Mazama bororo* (MAMMALIA: CERVIDAE) Diseño de primers especie-específicos". Informe de proyecto Financiado por Programa de Biodiversidade do Ministerio do Meio Ambiente- Brasil

Gottfried, G. J. 1987. *Effects of Modified Skidding Rules on Mixed Conifer Regeneration in Arizona*. USDA Forest Service. Research Note RM-479. Lakewood, Colorado

Green, T. (ed.) 2001. *Ecological and Socio-Economic Impacts of Close-to-Nature Forestry and Plantation Forestry: A Comparative Analysis*. EFI Proceedings number 37. European Forest Institute. Joensuu, Finland

Gregersen, H. M., K. N. Brooks, J. A. Dixon and L. S. Hamilton. 1987. Guidelines for economic appraisal of watershed management projects, FAO *Conservation Guide* No. **16**, FAO, Rome

Grela, I. 2004. Geografía florística de especies arbóreas de Uruguay: propuesta para la delimitación de dendrofloras. Tesis M.Sc. Montevideo, Uruguay, PEDECIBA - Universidad de la República. 97 p

Grieg-Gran, Maryanne. 1996. *Towards a Sustainable Paper Cycle*. International Institute for Environment and Development, London

Grönroos, J. 2007. Stora Enso and Forest Certification: Sustainability Fact Sheets, Stora Enso, London

Guiseppe, K. F. L., F. A. Drummond, C. Stubbs and S. Woods. 2006. *The use of glyphosate herbicide in managed forest ecosystems and their effects on non-target organisms with particular reference to ants as bioindicators*. Technical Bulletin 192. Maine Agricultural and Forest Experimental Station, University of Maine

Guynn Jr., D. C., S. T. Guynn, T. B. Wigley, and D. A. Miller. 2004. Herbicides and forest diversity—what do we know and where do we go from here? *Wildlife Society Bulletin* **32** (4): 1085–1092.

Halffter, G. 1998. Una estrategia para medir la biodiversidad a nivel de paisaje . In G. Halffter (ed.). La Diversidad Biológica de iberoamérica. Vol.II. *Acta Zool Mex*. (n.s.). Número especial :**3**-18

Halffter, G. and L. Arellano. 2002. Response of dung beetle diversity to human-induced changes in a tropical landscape. *Biotropica* **34**(1):144-154

Halffter, G. and M. Favila. 1993. The Scarabaeinae (Insecta: Coleoptera) an animal group for analizing, inventorying and monitoring biodiversity in tropical rainforest and modified landscapes. *Biology International* **27**:15-21

Halffter, G, C. Moreno and E. Pineda. 2001. *Manual para evaluación de la biodiversidad en Reservas de la Biosfera*. M&T- Manuales y Tesis SEA, vol.2. Zaragoza

Hall, R. 2003. Interception loss as a function of rainfall and forest types: stochastic modelling for tropical canopies revisited. *Journal of Hydrology* **280**: 1-12

Hammond, P. 1995. Practical approaches to the estimation of the extent of biodiversity in species groups. In D. Hawksworth (ed.). *Biodiversity: Measurement and Estimation*: 119-136. Chapman and Hall, London

Härmälä, J. 2006. Stora Enso Code of Ethics States, 5 December 2006, Stora Enso

Harper, R.J., G. Mauger, N. Robinson, J.F. McGrath, K.R.J. Smettem, J.R. Bartle and R.J. George. 2000. Manipulating Catchment Water Balance using Plantation and Farm Forestry: Case studies from South-Western AustraliaIn: S. Nambiar, and A.G. Brown (e4ds.). *Plantations, Farm Forestry and Water*. RIRDC Publication N^{o}. 01/20: 9-19

Hartley, M.J. 2002. Rationale and methods for conserving biodiversity in plantation forests. *Forest Ecology and Management* **155**: 81-95

Hartshorn, G. S. 1983. Ecological implications of tropical plantation forestry, in R. Sedjo (ed.) *The Comparative Economics of Plantation Forestry: A Global Assessment*, Resources for the Future, Washington DC

Haughton, A. J., J. R. Bell, N. D. Boatman and A. Wilcox. 1999. The effects of different rates of the herbicide glyphosate on spiders in arable field margins. The Journal of *Arachnology* **27**: 249-254

Hauser, S., S. Ngoumbe and B. A. Nkongmeneck. 2006. Effects on plant species composition of glyphosate application in a plantain system after secondary forest clearing. Conference on International Agricultural Research and Development. University of Bonn, October 11-13 2006

Hausermann, J. 1998. *A Human Rights Approach to Development,* A Discussion Paper Commission by the Department for International Development of the UK Government, Rights and Humanity, London

Hayes, J. P., S. H. Schoenholtz, M. J. Hartley, G. Murphy, R/ F. Powers, D. Berg, and S. R. Radosevich. 2005. Environmental Consequences of Intensively Managed Forest Plantations in the Pacific Northwest. *Journal of Forestry*. March 2005: 83-87

Hayter, Mairhead. 2003. *Review of Studies of the Socio-Economic Impact of Forest Industries in Australia*. Australian Government: Forest and Wood Products Research and Development Division. Victoria

Helle P. and M. Mönnönnen. 1990. Forest succession and birds communities: theoretical aspects and practical considerations. In Keast A. (ed.) *Biogeography and ecology of forest bird communities*. S. P. B. Academic Publishing. The Hague, Netherlands

Helliwell, R. C., R. C. Ferrier, L. Johnston, J. Goodwin and R. Doughty. 2001. Land use influences on acidification and recovery of freshwaters in Galloway, south-west Scotland. *Hydrology and Earth System Sciences* **5**(3): *451–458*

Helsingen Sanomat. 2007. "Demonstration at Stora Enso forest plantation in Brazil". 7th March 2007, Helsinki

Hellström, E. 1996. *Environmental Forestry Conflicts, Forest Policies and the Use of Forest Resources - Recent Developments in USA, Germany, France, Sweden, Finland and Norway*. Research Report number 7. European Forest Institute, Joensuu

Hines, C. 2000. *Localization: A global manifesto*. Earthscan, London

Hisham, Nohamad Ahmed, Jan Sharma, Anthony Ngaiza and Nicholas Atampugre. 1991. *Whose Trees? A People's View of Forestry Aid*. Panos Institute, London

Houston, C. S. and D. E. Bowen. 2001. Upland Sandpiper (*Bartramia longicauda*). *In*: A. Poole and F. Gill (eds.). *The Birds of North America*. Nr. 580. Philadelphia: Academy of Natural Sciences, Washington; American Ornithologists' Union

HSE (UK Health and Safety Executive). Undated http://www.hse.gov.uk/fod/pir0405.pdf#search=%22glyphosate%22

Hull, H., S. Freitag, S. Chown and C. Bellamy. 1988. Identification and evaluation of priority conservation areas for Buprestidae (Coleoptera) in South Africa, Lesotho, Swaziland and Namibia. *African Entomology* **6**: 265-274

Human Rights Impact Organisation (http://www.humanrightsimpact.org/about-the-hrirc/)

Humphrey, J. W., R. Ferris and C. P. Quine. 2003. *Biodiversity in Britain's Planted Forests.* Forestry Commission, Edinburgh

Hunter, M. L. 1990. Wildlife, forests and forestry: principles of managing forests for biological diversity. Prentice and Hall, Englewood Cliffs NJ

Hurst, P., A. Hay and N. Dudley. 1991. *The Pesticides Manual*. Journeyman Press, London and Concorde, Massachusetts

IFBWW (International Federation of Building and Wood Workers). 2004. *Exploitation of construction, forestry and wood workers in connection with migrant and cross border work*. Geneva

IFC (International Finance Corporation of the World Bank). 2006. Cumulative Impact Study Uruguay Pulp Mills: Annexe B: Plantations, International Finance Corporation

ILO Declaration concerning Fundamental Human Rights at Work

ILO Convention No. 29 concerning Forced Labour

ILO Convention No. 87 concerning Freedom of Association and Protection of the Right to Organize

ILO Convention No. 98 concerning the Right to Organize and Collective Bargaining

ILO Convention No. 105 concerning the Abolition of Forced Labour

ILO Convention No. 111 concerning Discrimination (Employment and Occupation)

ILO Convention No. 138 concerning Minimum Age

ILO Convention No. 169 concerning Indigenous and Tribal Peoples in Autonomous States http://www.unhchr.ch/html/menu3/b/62.htm

International Council on Human Rights Policy. 2002. *Beyond Voluntarism: human rights and the developing international legal obligations of companies*. At http://www.ichrp.org/ac/excerpts/41.pdf

International Covenant on Civil and Political Rights (1966)

International Covenant on Economic, Social, and Cultural Rights (1966)

ITTO. 2002. *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests,* ITTO Policy Series No 13, International Tropical Timber Organisation, Yokohama, Japan

IUCN 2006. 2006 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 16 March 2007

Jackson, R.B.; Jobbagy, E.G.; Avissar, R., Roy, S.B.; Barret, D.J.; Cook, C.W.; Farley, K.A.; Maitre, D.C.; McCarl, B.A.; Murray, B.C., 2005. Trading water for carbon with biological carbon sequestration. *Science* **310**: 1944-1947

James, R. and A. del Lungo. 2005. *The potential for fast-growing commercial forest plantations to supply high-value roundwood*. Planted Forests and Trees Working Paper FP 33. FAO, Rome

Jactel, H., E. Brockerhoff and P. Duelli. 2005. A Test of the Biodiversity-Stability Theory: Meta-analysis of Tree Species Diversity Effects on Insect Pest Infestations, and Re-examination of Responsible Factors. In. M. Scherer-Lorenzen, C. Körner and E.-D. Schulze (eds.) *Forest Diversity and Function: Temperate and Boreal Systems*, Ecological Studies number 176, Springer, Berlin and Heidelberg

Jactel, H., A. Franc, J. M. Carnus, C. Quine, E. Brockerhoff, J. Sayer, J. Parrotta, A. Marjokorpi. 2005. Biodiversity and Plantation Forests: An overview. Final summing up from the workshop Biodiversity and Conservation Biology in Plantation Forests, IUFRO, Bordeaux, April 2005

Janz, D. M., A. P. Farrell, J. D. Morgan and G. A. Vigers. 1991. Acute physiological stress responses of juvenile Coho salmon (*Oncorhynchus kisutch*) to sublethal concentrations of Garlon 4®, Garlon 3A® and Vision® herbicides. *Environmental Toxicology and Chemistry* **10**: 81–90.

Janzen, D. 1987. How to grow a tropical national park. *Experentia* **43**: 1037-1038

Jenkin, B. M. and B. Tomkins. 2006. *Pesticides in Plantations: The use of chemical pesticides by the Australian plantation forest industry*. Forest and Wood Products Research and Development Corporation, Australian Government

Jerry, M. L. 2004. Best Management Practices for Silvicultural Chemicals and the Science Behind Them, *Water, Air, & Soil Pollution: Focus* **4** (1): 95-117

Jiayu, B. and G. Siming. 1996. Eucalyptus Plantations in China, In: FAO, *Reports Submitted to the Regional Expert Consultation on Eucalyptus - Volume II*, FAO, Rome, Italy

Jobbagy, E.G. 2002. PhD thesis, Duke University, Durham, NC, USA

Jungk, M. 2001a *Deciding Whether to do Business in States with Bad Governments,* The Confederation of Danish Industries, The Danish Centre for Human Rights, and the Danish Industrialization Fund for Developing Countries, 2001a. Available at http://rru.worldbank.org/documents/PapersLinks/6387.pdf (accessed 1 May, 2007)

Jungk, M. 2001b. *Defining the Scope of Business Responsibility for Human Rights Abroad*, the Danish Centre for Human Rights, the Confederation of Danish Industries, and the Industrialization Fund for Developing Countries, 2001b. Available at
http://www.ipieca.org/activities/social/downloads/member_topics/Danish_Centre_article.pdf (accessed 1 May, 2007)

Kanowski, Peter. 2005. *Intensive planted forests*. The Forest Dialogue, Yale, New Haven

Keenan, R. J., M. Parsons, A. Gerrand, E. 'Loughlin, S. Beavis, S., D. Gunawardana, M. Gavran. and A. Bugg. 2004. Plantations and water use: a review prepared for the Forest and Wood Products Research and Development Corporation. Bureau of Rural Sciences, Canberra

Keenan, R. J., A. Gerrand, S. Nambiar and M. Parsons. 2006 (revised edition). Plantations and Water: Plantation impacts on stream flow. Science for Decision-Makers. Australian Government Bureau of Rural Sciences

Keeves, A. 1966. Some evidence of loss of productivity with successive rotations of *Pinus radiata* in the south east of South Australia. *Australian Forestry* **30**: 51-63

Kelly, G. and K. Lymon. 2003. *To Trees or Not to Trees? An Assessment of the Social Impact of the Plantation Industry on the Shire of Plantagenet*. Forests and Wood Products, Research and Development Corporation, Australian Government, Australia

Klein, B. 1989. Effects of forest fragmentation on dung and carrion beetle communities in central Amazonia. *Ecology* **70**(6): 1715-1725

Knight Merz, S. Undated. *Productive Trees, Healthy Landscapes: A guide to improving biodiversity in private forestry within the Central Victorian Farm Plantations Region*. Central Victorian Farm Plantations Inc

Knutson, M. G., J. R. Sauer, D. A. Olsen, M J. Mossman, L. M. Hemesath and M. J. Lannoo. 1999. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, USA. *Conservation Biology* **13**(6): 1437 – 1446

Knutson, M. G., J. R. Sauer, D. A. Olsen, M J. Mossman, L. M. Hemesath and M. J. Lannoo. 2000. Landscape associations of frog and toad species in Iowa and Wiconsin, USA. *Journal of Iowa Academy of Sciences* **107**(3): 134 – 145

Kroesa, Renate. 1990. *The Greenpeace Guide to Paper*. Greenpeace International, Amsterdam

Kuczera, G. 1987. Prediction of water yield reductions following a bushfire in ash-mixed species eucalypt forest. *Journal of Hydrology* **94**: 215-236

Lai, R. 1997. Soils of the tropics and their management for plantation forestry. In S. Nambiar and A. Brown (eds.) *Management of soil nutrients and water in tropical plantation forests*. Australian Centre for International Agricultural Research. ACIAR Monograph Series No. 43: 97-123

Lane, P. N. J., A. E. Best, K. Hickel and L. Zhang. 2005. The response of flow duration curves to afforestation. *Journal of Hydrology* **310** (1-4): 253-265

Lautenschlager, R. A. 1993. Response of wildlife to forest herbicide applications in northern coniferous ecosystems. *Canadian Journal of Forestry Research* **23**: 2286–2299.

Lautenschlager, R. A., and T. P. Sullivan. 2002. Effects of herbicide treatments on biotic components in regenerating northern forests. *Forestry Chronicle* **78** (5): 695–731.

Lautenschlager, R. A., and T. P. Sullivan. 2004. Improving research into the effects of forest herbicide use on biota in northern ecosystems. *Wildlife Society Bulletin* **32** (4): 1061–1070.

Leach, Gerald and Robin Mearns. 1988. *Beyond the Fuelwood Crisis: People, Land and Trees in Africa*. Earthscan Publications, London

Lemckert, F., T. Brassil and A. Towerton. 2005. Native vegetation corridors in exotic pine plantations provideo long-term habitat for frogs. *Ecological Management and Restoration*, **6**(2): 132-134

Lemenih, M. 2006. Expediting ecological restoration with the help of foster tree plantations in Ethiopia. *Journal of the Drylands* **1** (1): 72-84

Leonel. M. H. 2005. Forest plantations in Brazil. Address to the FAO Advisory Committee on Paper and Wood Products. Vacouver, May 31 2005

Locklin, Claudia. 2001. Uruguayan savannah ecoregion, summarised in the website http://www.worldwildlife.org/wildworld/profiles/terrestrial/nt/nt0710_full.html

Lowe S., M. Browne S. Boudjelas and M. De Poorter. 2004. *100 of the World's Worst Invasive Alien Species A selection from the Global Invasive Species Database*. The Invasive Species Specialist Group (ISSG**),** Species Survival Commission IUCN The World Conservation Union

Loyn, R.H., E. G, McNabb, P. Macak and P. Noble. 2007. Eucalypt plantations as habitat for birds on previously cleared farmland in south-eastern Australia. *Biological Conservation* **137**: 533–548

MacKinnon, D. S. and B. Freedman. 1993. Effects of Silvicultural Use of the Herbicide Glyphosate on Breeding Birds of Regenerating Clearcuts in Nova Scotia, Canada**.** *The Journal of Applied Ecology* **30** (3): 395-406

Majer, J. and G. Beeston. 1996. The Biodiversity Integrity Index: An illustration using ants in Western Australia. *Conservation Biology* **10**(1): 65-73

Maneyro, R. and M. Beheregaray. In press. First record of *Physalaemus cuvieri* Fitzinger, 1826 (Anura, Leptodactylidae) in Uruguay, with comments on the anuran fauna along the borderline Uruguay-Brazil. *Boletín de la Sociedad Zoológica del Uruguay*

Maneyro, R. and S. Carreira. 2006. La herpetofauna de la costa uruguaya. In: Menafra et al (eds.): *Bases para la conservación y el manejo de la costa uruguaya*. Editorial Graphis. Montevideo: 233 – 246

Maneyro, R., F. Forni and M. Santos. 1995. Los anfibios del departamento de Rocha. Serie Divulgación Técnica. PROBIDES **I**: 1-24

Marc, J., O. Mulner-Lorillon and R. Bellé. 2004a. Glyphosate-based pesticides affect cell cycle regulation. *Biology of the Cell* **96**: 245–249

Marc, J., M. Le Breton, P. Cormier, J. Morales, R. Belle´and O. Mulner- Lorillon. 2004b. A glyphosate-based pesticide impinges on transcription, *Toxicology and Applied Pharmacology* **203**: 1 – 8

Marchesi, E. 2005. Flora y vegetación del Uruguay. Project Orion. Environmental Impact Assessment. Capítulo 5: Características del ambiente receptor, IFC

Matthews, G. A. 1979. *Pesticide Application Methods*. Longmans, London

Mayers J. and S. Vermeulen. 2002. *Company-community forestry partnerships: From raw deals to mutual gains? An international review with proposals for improving forests, enterprise and livelihoods*. International Institute for Environment and Development, London, UK

MCPFE [Ministerial Conference on the Protection of Forests in Europe]. 2003. *Improved Pan-European Indicators for Sustainable Forest Management as adopted by the MCPFE Expert Level Meeting 7-8 October 2002, Vienna, Austria*. MCPFE, Vienna

McNeely, J. A. (ed.). 2001. *The Great Reshuffling: Human dimensions of invasive alien species*. IUCN The World Conservation Union, Gland, Switzerland

McShane, T. O. and E. McShane-Caluzi. 1997. Swiss forest use and biodiversity conservation, In *Harvesting Wild Species: Implications for Biodiversity conservation* (ed.) C H Freese, John Hopkins University Press, Baltimore and London

Mercer, D. and A. Underwood. 2002. Australian timber plantations: national vision, local response. *Land Use Policy* **19**: 107-122

Millán, A., J. Moreno and J. Velasco. 2001a. Estudio faunístico y ecológico de los coleóptros y heterópteros acuáticos de las lagunas de Alb acete (Alboraj, Los Patos, Ojos de Villaverde, Ontafia y Pétrola). *Sabuco* **1**:43-94

Millán, A., J. Moreno and J. Velasco. 2001b. Estudio faunístico y ecológico de los coleópteros y heterópteros acuáticos de las lagunas y humedales de Albacete. *Sabuco* **2**:167-214

Miller, Alan S., Irving M. Mintzer and Sara H. Hoagland. 1986. *Growing Power: Bioenergy for development and industry*. World Resources Institute, Washington DC

Mones, A., J. González, R. Praderi and M. Clara 2003. Diversidad de la Biota Uruguaya. Mammalia. Anales del Museo de Historia Natural de Montevideo 2ª seria 10 (4): 1-28

Monsanto. 2005. *Backgrounder : Summary of Human Risk Assessment and Safety Evaluation on Glyphosate and Roundup herbicide*, Monsanto, MO, US

Montagnini, F. 2005. "Attempting to Restore Biodiversity in Even-Aged Plantations". In: S. Mansourian, D. Vallauri, and N. Dudley (eds.) *Forest Restoration in Landscapes: Beyond Planting Trees*. Springer, New York, USA

Montreal Process. 1999. *Criteria and Indicators*. http://www.mpci.org/rep-pub/1999/broch_e.html accessed 17th July 2007

Moore, B. 2007. *Overview of Forests Pests: Uruguay*. Forest Health and Biosecurity Working Papers, FAO, Rome

Morales Fagundes, S. and S. Carreira. 2001. Calificación del estado de conservación de la fauna de ofidios (Reptilia, Squamata, Serpentes) de Uruguay. *FACENA* **16**: 45-51

Morales, V. 2006. The Economic Impact of the Forest Sector in Uruguay: Survey results. Presentation to the 2006 IUFRO Plantations Meeting, Charleston, South Carolina, October 13 2006

Morelli, E.; P. Gonzalez-Vainer and A. Baz. 2002. Coprophagous beetles (Coleoptera: Scarabaeoidea) in Uruguayan prairies: Abundance, diversity and seasonal occurrence. *Studies on Neotropical Fauna and Environment* **37**(1): 53-57

Morgan, J. D., D. M. Janz, G. A. Vigers, and A. P. Farrell. 1989. *Determination of threshold concentrations of forest-use herbicides causing rapid sublethal toxic effects towards salmonid fish*. Forest Resource Development Agreement, B.C. Ministry of Forests, Forestry Canada, FRDA Project No. 2.46.

Morgan, J. D., D. M. Janz, G. A. Vigers, and A. P. Farrell and D. M. Janz. 1991. Acute avoidance reactions and behavioral responses of juvenile rainbow trout (*Oncorhynchus mykiss*) to Garlon 4®, Garlon 3A® and Vision® herbicides. Environmental Toxicology and Chemistry **10**: 73–79.

Myers, N. 1979. *The Sinking Ark: A new look at the problem of disappearing species*. Pergamon Press, Oxford

Myers, N. R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* **403**: 853-858

Nasi, R. 2005. Impact of corridor design and management in a large-scale industrial plantation landscape, from the workshop Biodiversity and Conservation Biology in Plantation Forests, IUFRO, Bordeaux, April 2005

Neal, C., B. Reynolds, M. Neal and B. Williams. 2004. The hydrochemistry of plantation spruce forest catchments with brown earth soils, Vyrnwy in mid-Wales. *Hydrology and Earth System Sciences* **8**(3), 460-484

Newmaster, S. G., and F. W. Bell. 2002. The effects of silvicultural disturbances on cryptogam diversity in the boreal-mixed wood forest. *Canadian Journal of Forestry Research* **32** (1): 38–51.

Nores, Manuel, Maria M. Cerana and Diego A. Serra. 2005. Dispersal of forest birds and trees along the Uruguay River in southern South America. *Diversity and Distributions* **11**(3): 205-217

Nuñez, D., R. Maneyro, J. A. Langone and R. O. de Sá. 2004. Distribución geográfica de la fauna de anfibios del Uruguay. *Smithsonian Herpetological Information Service*, (134): 1-34

O'Laughlin, E. and E. K. S. Nambiar 2001. *Plantations, Farm Forestry and Water: A discussion paper*. A report for the RIRDC/LWA/FWPRDC Joint Venture Agroforestry Program. Water and Salinity Issues in Agroforestry No. 8. RIRDC Publication No. 01/137. Rural Industries Research and Development Corporation, Barton ACT, Australia

Pallarés, Olegario Royo, Elbio J. Berretta and Gerzy E. Maraschin. 2005. The South American Campos Ecosystem. In: *Grassland of the World*. [Edited] J.M. Suttie, S.G. Reynolds and C. Batello. Food and Agricultural Organization of the United Nations. Rome

Palmer, M., 1999. The application of biogeographical zonation and biodiversity assessment to the conservation of freshwater habitats in Great Britain. *Aquatic Conservation-Marine and Freshwater Ecosystems* **9**: 179-208

Panario, Daniel, and Mario Bidegain. 1997. "Climate change effects on grasslands in Uruguay," *Climate Research* **9** (1-2): 37-40

Parr, S. J. 1994. Changes in the population size and nest sites of Merlins *Falco columbarius* in Wales between 1970 and 1991. *Bird Study* **41**: 42-47

Parris, K. M. and D. B. Lindenmayer. 2004. Evidence that creation of a *Pinus radiata* plantation in south-eastern Australia has reduced habitat for frogs. *Acta Oecologica* **25**: 93 – 101

Parrish, J. D. and L. J. Petit. 1996. Value of shade coffee plantations for tropical birds: Landscape and vegetation effects. Proceedings of the International Conference of Environmental Enhancement Through Agriculture. Nov. 1995, Boston, MA

Parrota, J. A., J. W. Turnbull and N. Jones. 1997. Catalyzing native forest regeneration on degraded tropical lands. *Forest Ecology and Management* **99**: 1-7

Pearson, D., 1994. Selecting indicator taxa for the quantitative assessment of biodiversity. *Philosophical Transactions of the Royal Society of London, Series B* **345**:75-79

Pearson, D. and F. Cassola 1992. World-wide Species Richness Patterns of Tiger Beetles (Coleoptera:Cicindelidae): Indicator Taxon for Biodiversity and Conservation Studies. *Conservation Biology* **6** (3): 376-390

Pennington, P. I. and M. Laffan. 2004. Evaluation of the use of pre- and post-harvest bulk density measurements in wet *Eucalyptus obliqua* forest in Southern Tasmania. *Ecological Indicators* **4**: 39-54

Perlin, John. 1989. *A Forest Journey: The role of wood in the development of civilisation*. Harvard University Press, Cambridge Massachusetts, p 67

Peterson, R. K., and A. G. Hulting. 2004. A comparative ecological risk assessment for herbicides used on spring wheat: the effect of glyphosate when used within a glyphosate-tolerant wheat system. *Weed Science* **52**: 834–844.

Pharo, E., A. Beattie and D. Binna. 1999. Vascular plant diversity as a surrogate for bryophyte and lichen diversity. *Conservation Biology* **13**: 282-292

PIER (Pacific Island Ecosystems at Risk). Undated. http://www.hear.org/Pier/wra/pacific/eucalyptus_dunnii_htmlwra.htm (accessed 6th August 2007)

Poore, M. E. D. and C. Fries. 1985. *The Ecological Effects of Eucalyptus*. FAO Forestry Paper 59. Food and Agricultural Organization of the United Nations, Rome

Poore, M. E. D. 1993. *Guidelines: Shell/WWF Tree Plantation Review*. Shell International Petroleum Company Ltd and WWF UK

Pretty, J. and G. Conway. 1988. *The Blue Baby Syndrome and Nitrogen Fertilisers: A High Risk in the Tropics?* Gatekeeper Series number 5. International Institute for Environment and Development, London

Red Uruguay de ONGs Ambientalistas de Uruguay. 2006. *Comentarios De La Red Uruguaya De Ongs Ambientalistas De Uruguay (Red) Al Estudio De Impactos Acumulativos De La Instalación De Plantas De Celulosa En Fray Bentos, Realizado Por La Corporación Financiera Internacional (Bm),* Red Uruguay de ONGs Ambientalistas de Uruguay, Uruguay

Relyea, R. A. 2005a. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. *Ecological Applications* **15**(2): 618-627

Relyea, R. A. 2005b. The lethal impact of Roundup on aquatic and terrestrial amphibians. *Ecological Applications* **15**(4): 1118-1124

Renderos Durán, R. V., J.-M. Harmand, F. Jiménez, and D. Kass. 2002. Contaminación del agua con nitratos en microcuencas con sistemas agroforestales de Coffea arabica con *Eucalyptus deglupta* en la Zona Sur de Costa Rica. *Agroforestería en las Américas* **9**: 35-36)

Republica Oriental del Uruguay, OEA, and BID. 1992. Estudio Ambiental Nacional: Plan de Accion Ambiental. Organizacion de los Estados Americanos, Washington, DC.

Ribera, I., J. E. Hogan and A. P. Vogler. 2002. Phylogeny of Hydradephagan water beetles inferred from 185 rRNA sequences. *Molecular Phylogenetics and Evolution* **23**(1) 43-62

Richard, B. N. 1993. *Guidelines for Site Classification and Determination of Fertilizer Requirements of Industrial Forest Plantations*. Asian Development Bank

Richardson, D. M. and R. J. Petit. 2006. Pines as Invasive Aliens: Outlook on Transgenic Pine Plantations in the Southern Hemisphere. In: *Landscapes, Genomics and Transgenic Conifers*. (eds.) C. G. Williams. Springer

Richardson, D. M. (ed.). 1998. *Ecology and Biogeography of* Pinus. Cambridge University Press

Richoux, P. 1994. Theoretical habitat templates, species traits, and species richness: aquatic Coleoptera In the Upper Rhône River and its floodplain. *Freshwater Biology* **31**: 377-395

Ricketts T., G. Daily and P. Ehrlich. 2002. Does butterfly diversity predict moth diversity? Testing a popular indicator taxon at local scales. *Biological Conservation* **103**: 361-370

Robinson, M. 2001. UN High Commissioner for Human Rights, BP Annual Lecture, The British Museum, November 2001, cited by Amnesty International and and the Prince of Wales International Business Leaders Forum (IBLF) at http://www.iblf.org/resources/general.jsp?id=69

Roche, M. M. and R. B. Le Heron. 1993. New Zealand: Afforestation policy in eras of state regulation and de-regulation. In A. Mather (ed.) *Afforestation: Policies, planning and progress*. Belhaven Press, London

Rodríguez, Claudia, Elsa Leoni, Felipe Lezama and Alice Altesor. 2003. Temporal trends in species composition and plant traits in natural grasslands of Uruguay. *Journal of Vegetation Science* **14**: 433-440

Rosengurtt, B. 1944. Las formaciones campestres y herbáceas del Uruguay. Serie: *Estudios sobre praderas naturales del Uruguay. 4ª Contribución.* Gallinal, J.P.; Bergalli, L.; Campal, E.F.; Aragone, L.; Rosengurtt, B. Revista Agros Nº 34 [Check date says 1975 in main text]

Rosoman, G., 1994. *The Plantation Effect*. Greenpeace New Zealand. 48p.

Rusch, V. T. Schlichter and J Corley. 2005. Integration of spatial scales for the conservation of biodiversity in forest plantations, from the workshop Biodiversity and Conservation Biology in Plantation Forests, IUFRO, Bordeaux, April 2005

Sahin V. and M. J. Hall. 1996. The effects of afforestation and deforestation on water yields. *Journal of Hydrology* **178**(1–4): 293–309

Sargent, C. 1992. Natural forest or plantation? In C. Sargent and S. Bass (eds.) *Plantation politics: Forest plantations in development*. Earthscan Publishers, London: 16-40

Sawyer, J. 1994. *Plantations in the Tropics: Environmental Concerns*. IUCN Forest Conservation Programme, IUCN, Gland

Sayer, J., Campbell B., Petheram L., Aldrich M., Ruiz Perez M., Endamana D., Dongmo Z., Defo L., Mariki S., Doggart N., Burgess N, 2006. Assessing environment and development outcomes in conservation landscapes, *Biodiversity Conservation*

Schirmer, J. 2006. Socio-economic impacts of plantations: findings from recent research, presentation at Plantation Forestry Seminar, DPI Hamilton 1st February 2006 from Australia National University

Schirmer, J. 2007. Plantations and social conflict: exploring the differences between small-scale and large-scale plantation forestry. *Small-scale Forestry* **6** (1): 19-33

Schirmer, J. Kanowski, P. and Race, D. 2000. Factors affecting adoption of plantation forestry on farms: implications for farm forestry development in Australia. *Australian Forestry* **63**: 44-51

Schirmer, J., M. Parsons, C. Charakambou and M. Garvan. 2005. Socio-Economic Impacts of Plantation Forestry in the South West Slopes of NSW, 1991 to 2004. Report produced for FWPRDC Project PN04/4007. Forest and Wood Products Research and Development Corporation. Melbourne

Scott, D.F., 2005. On the hydrology of industrial timber plantations. *Hydrological Processes* **19**: 4203-4206.

Scott, D.F. and W. Lesch. 1997. Streamflow responses to afforestation with *Eucalyptus grandis* and *Pinus patula* and to felling in the Mokobulaan experimental catchments. *South African Journal of Hydrology* **199**: 360–377

Sedjo, R. and D. Botkin. 1997. Using forest plantations to spare national forests. *Environment* **39** (10):14–20, 30

Sedlak, O. 1988a. *Principles of Forest Road Nets.* Food and Agriculture Organisation of the United Nations, Rome

Sedlak, O. 1988b. *Maintenance of Forest Roads*. Food and Agriculture Organisation of the United Nations, Rome

Sedlak, O. 1994. Forest harvesting and environment in Austria, paper presented at the Meeting of Experts on Forest Practices. FAO, Rome

Shiva, V. and J. Bandyopadhyay. 1985. *Ecological Audit of Eucalyptus Cultivation*. The English Book Depot, Dehradun, India

Shure, D. and D. Phillips. 1991. Patch size of forest openings and arthropod populations. *Oecologia* **86**: 325-334

Sluys, R. 1999. Global diversity of land planarians (Platyhelminthes, Tricladidda, Terricola): a new indicator-taxon in biodiversity and conservation studies. *Biodiversity and Conservation* **8**: 1663-1681

Smit, W. and M. Pitcher. 2003. *A Case Study on Ensuring Sustainable Management of Planted Forests: The Economic, Social and Environmental Role of Commercial Plantations in South Africa,* presented at the UNFF Intersessional Experts Meeting on the Role of Planted Forests in Sustainable Forest Management, 24-30 March 2003, New Zealand

Smith, N. 1981. *Wood: An ancient fuel with a new future*. Worldwatch Paper number 42. Worldwatch Institute, Washington DC

Smith, V. H., G. D. Tilman and J. C. Nekola. 1999. Eutrophication: impacts of excess nutrient inputs on freshwater, marine, and terrestrial ecosystems. *Environmental Pollution* **100**: 179-196

Snoeck, M., C. Casacuberta, R. Domingo, H. Pastori and L. Pittaluga. 2007. *The Emergence of New Successful Export Activities in Uruguay*. IADB project – Latin American Research Network. Universidad de la Repubica, Montevideo

Södergren, Anders [editor]. 1988. Biological Effects of Bleached Pulp Mill Effluents. National Swedish Environmental Protection Board Report 3558. NSEPB, Solna, Sweden.

Soriano, A. 1991. Río de la Plata grasslands. In *Natural grasslands. Introduction and Western Hemisphere*. Coupland, R. T. (ed.). Ecosystems of the world 8A. Amsterdam, Elsevier. 367 - 407

Soutullo, A. and E. Gudynas 2006. How effective is the MERCOSUR's network of protected areas in representing South America's ecoregions? Oryx **40** (1)

Stape, J. L., D. Binkley, M. G. Ryan and A. D. N. Gomes. 2004a. Water use, water limitation and water use efficiency in a Eucalyptus plantation. *Bosque* **25** (2): 35-41

Stape, J. L., D. Binkley and M. G. Ryan. 2004b. Eucalyptus production and the supply, use and efficiency of use of water, light and nitrogen across a geographic gradient in Brazil. *Forest Ecology and Management* **193**: 17-31

Stape, J. L., D. Binkley. W. S. Jacob and E. N. Takahashi. 2006. A twin-plot approach to determine nutrient limitation and potential productivity in Eucalyptus plantations. *Forest Ecology and Management* **223**: 358-362

Stattersfield, A.J., M. J. Crosby, A. J. Long, and D. C. Wege, editors. 1998. *Endemic bird areas of the World: Priorities for biodiversity conservation*. BirdLife International, Cambridge, UK.

Steinfeld, H., P. Gerber, T. Wassenaar, V. Castel, M. Rosales and C. de Haan. 2006. *Livestock's Long Shadow: Environmental issues and options*. FAO, Rome

Stewart, W. D. P. and T. Rosswall. 1983. *The Nitrogen Cycle in the United Kingdom – A study group report*. The Royal Society, London

Stiglitz, J. 2002. *Globalization and its Discontents*. Penguin Books, Middlesex

Stora Enso (2007); *Company 06*, Sora Enso, Helsinki, Stockholm and London

Strauss, S. H., P. Coventry, M. Campbell, S. M. Pryor and J. Burley. 2001. Certification of genetically modified forest plantations. *International Forestry Review* **3** (2): 85-102

Stroud, David A., T. M. Reed, M. W. Pienkowski and R. A. Lindsay. Undated. Birds, Bogs and Forestry: The Peatlands of Caithness and Sutherland. Nature Conservancy Council, Peterborough, UK

Sullivan, T. P. 1994. Influence of Herbicide-Induced Habitat Alteration on Vegetation and Snowshoe Hare Populations in Sub-Boreal Spruce Forest. *The Journal of Applied Ecology* **31** (4): 717-730

Sullivan, T. P. and D. S. Sullivan. 1982. Responses of Small-Mammal Populations to a Forest Herbicide Application in a 20-Year-Old Conifer Plantation. *The Journal of Applied Ecology* **19** (1): 95-106

Sullivan T. P. and D. S. Sullivan. 2003. Vegetation management and ecosystem disturbance: impact of glyphosate herbicide on plant and animal diversity in terrestrial systems. *Environmental Review* **11** (1): 37–59 (2003)

Swank, W. T. and J. D. Helvey. 1970. Reduction in streamflow increases following regrowth of clearcut hardwood forests. In S*ymposium on the Results of Research on Representative and Experimental Basins*. Wellington, New Zealand

Swank, W. T., J. M. Vose and K. J. Elliott. 2001. Long-term hydrologic and water quality responses following commercial clearcutting of mixed hardwoods on a southern Appalachian catchment. *Forest Ecology and Management* **143**: 163-178

Swanson, F. J., J. A. Jones and G. E. Grant. 1997. The physical environment as a basis for managing ecosystems. In *Creating Forestry for the 21st Century: The science of ecosystem management*. (eds.) K. A. Kohm and J. F. Franklin. Earh Island Press, Covelo California and Washington DC

Tattersfield, P., M. B. Seddon, and C. N. Lang. 2001. Land-snail faunas in indigenous rainforest and commercial forestry plantations in Kakamega Forest, western Kenya. *Biodiversity and Conservation* **10** (11): 1809-1829

Tompkins, S. C. 1986. *The Theft of the Hills: Afforestation in Scotland*. The Ramblers Association and the World Wildlife Fund, London

Tree Plantations Australia. 2005. *Plantations and Water Roundtable Summary: Canberra 20 April 2005* (leaflet). Deakin, ACT, Australia

UNDP (United Nations Development Program) 2000. *Human Development Report 2000: Human rights and human development.* Oxford University Press, Inc, New York

UNESCO. 1999. *Practices on the application of the Convention for the Protection of World Heritage*. UNESCO, Paris: Articles 37, 38

US EPA (Environmental Protection Agency). Undated. http://www.epa.gov/safewater/contaminants/dw_contamfs/glyphosa.html

US Forest Service (undated) http://www.fs.fed.us/database/feis/plants/weed/index.html (accessed 6th August 2007)

Van Wyke, D. B. 1098. Some effects of afforestation on streamflow in the Western Cape Province, South Africa. *Water South Africa* **13**: 31-36

Vaz, J. Undated. *The Kinabatangan Floodplain: An Introduction*. WWF and the Ministry of Tourism, Sabah.

Vaz-Ferreira, R., L. Covelo de Zolessi and F. Achaval. 1970. Oviposición y desarrollo de ofidios y lacertilios en hormigueros de *Acromyrmex*. *Physis* **29** (79): 431-459

Vaz-Ferreira, R., L. Covelo de Zolessi and F. Achaval. 1973 Oviposición y desarrollo de ofidios y lacertilios en hormigueros de *Acromyrmex* II. Trab. V Congr. Latinoam. Zool. **1**: 232-244

Vertessy, R.A., 2000. Impacts of plantation forestry on catchment runoff. In: S. Nambiar, and A.G. Brown (e4ds.). *Plantations, Farm Forestry and Water*. RIRDC Publication N^{o}. 01/20: 9-19

Vertessy, R.A.; F.G.R. Watson and S.K. O´Sullivan. 2001. Factors determining relations between stand age and catchment water balance in mountain ash forests. *Forest Ecology and Management* **143**: 13-26

Victoria, C., A. Kacevas and H. Fiori. 1997. Soil vulnerability in Uruguay: Potential effects of an increase in erosive rainfall on soil loss. *Climate Research* **9**: 41-46

von Stackelberg, N. O., G. M. Chescheir, R. W. Skaggs, D. M. Amatya. 2007. Simulation of the hydrologic effects of afforestation in the Tacuarembó River Basin, Uruguay. *American Society of Agricultural and Biological Engineers* **50** (2): 455-468

Watkins, Charles [editor]. 1993. Ecological Effects of Afforestation. CAB International, Oxford

Weber, F. 1977. *Reforestation in Arid Lands*. Volunteers in Technical Assistance, Mt Rainier, USA

Wheeler, G. L., K. F Steele and E. R. Lawson. 2000. Water and nutrient movement in small, forested watersheds in the Boston mountains of Arkansas. *Forest Science* **46**: 335-343

White, A. and A Martin. 2002. *Who Owns the World's Forests?* Forest Trends, Washington D.C.

White, D.A., C.L. Beadle, M. Battaglia, R.G. Benyon, F.X. Dunin and J.L. Medhurst. 2000. A Physiological Basis for Management of Water Use by Tree Crops. In S. Nambiar, and A.G. Brown, (Eds.). *Plantations, Farm Forestry and Water*. RIRDC Publication N^{o}. 01/20: 9-19

WHO (World Health Organisation). 2004. *Glyphosate and AMPA in Drinking-water* (Summary statement Extract from Chapter 12 – Chemical fact sheets of WHO Guidelines for Drinking-water Quality, 3rd edition, 2004), WHO, Geneva, Switzerland

Williams G. M., K. Kroes and I. C. Munro. 2000. Safety evaluation and risk assessment of the herbicide Roundup and its active ingredient, glyphosate, for humans. *Regulatory Toxicology and Pharmacology* **31** (2 Pt 1): 117-65

Wilson, A. and C. Gribben. 2000. *Business Responses to Human Rights*, Ashridge Centre for Business and Society: United Kingdom, Available at: http://www.ashridge.org.uk/Website/IC.nsf/wFARATT/Business%20Responses%20To%20Human%20Rights/$file/BusinessResponsesToHumanRights.pdf (accessed 1 May 2007)

Zhang, L.; Dawes, W.R.; Walker, G.R., 2001. Response of mean annual evapotranspiration to vegetation changes at catchment scale. *Water Resources Research* **37**: 701-708

Ziegler, J. (Special Rapporteur on the right to food). 2003. *Note by the Secretary-General*, 28 August 2003, UN Doc. A/58/330